This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

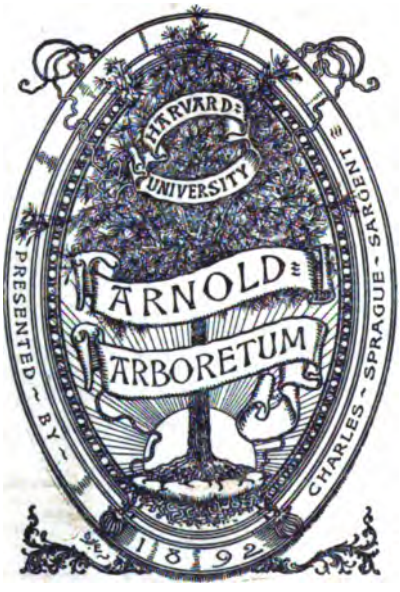
+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

T&f
Si4
tre

JP



~~DEPOSITED AT THE HARVARD FOREST~~
1943

RETURNED TO J. P.
MARCH, 1967

WILLIAM WESLEY & SON,
ksellers & Publishers,
ssex Street, Strand,

Frontispiece.

PART OF GOVERNMENT NURSERY, CEDARA.

BULLETIN 7.

NATAL

DEPARTMENT OF AGRICULTURE.

TREE PLANTING IN NATAL

BY

T. R. SIM, F.L.S., F.R.H.S.,

CONSERVATOR OF FORESTS.

1905:

P. DAVIS & SONS, PRINTERS AND PUBLISHERS,
PIETERMARITZBURG,
NATAL.

Jan. 1908
17394

PREFACE.

This Bulletin consists of off-prints and reprints of articles by the author, which have appeared in the "Natal Agricultural Journal," edited only to the extent of avoiding repetitions, but supplemented by such additional chapters or particulars as appeared necessary to make it a fairly complete treatise on the subject in hand.

Tree planting for the purposes of timber-production, shelter, and ornament have been dealt with here, but the planting and culture of fruit trees have been omitted, as being sufficiently distinct to require separate treatment. The great variation of climate and altitude found within Natal produces naturally several zones of vegetation in the indigenous tree-flora, and necessitates the separation of exotics into corresponding zones, limited in accordance with the elasticity of nature of each species used. Consequently, although the chapters on methods of culture apply in principle to all parts of the Colony, and, indeed, to all parts of South Africa, it has been found necessary in the treatment of species to divide the Colony into three belts corresponding to vegetation zones. These belts are nowhere definitely delimited; they overlap more or less wherever they meet, but in a general way are sufficiently distinct to act as guides to intending tree planters.

Experience in Cape Colony, as well as observation in other parts of South Africa and abroad, have been largely utilised in the preparation of this Bulletin, although Natal experience, founded on the observation of success or failure achieved by farmers and others who started tree planting many years ago before this Department came into existence, has been accepted as the ruling index wherever such exists.

The need for some such treatise as this has been amply demonstrated by the numerous enquiries made concerning kinds of trees and methods of treatment, and though the author invites, and welcomes, such enquiries, he trusts that many correspondents will read herein for themselves what otherwise would have incurred a separate reply from him. He trusts also that the information given will prove interesting, accurate, and useful, and that it will assist in producing a widespread interest in what is at once a most useful occupation, and a most interesting hobby. The preparation of illustrations was commenced at the instance of Hon. H. D. Winter, while Minister of Agriculture, on purpose that the public might have an opportunity of knowing the general aspect of any species before planting it, and the present Minister of Agriculture, the Hon. W. F. Clayton, has sanctioned the extended use of illustrations with the same end in view.

These illustrations are taken from Natal-grown trees, and consequently show not only what can be done, but also what has actually been accomplished in Natal.

The protection and working of the indigenous forests, forming quite a separate branch of forestry have not been taken up here.

T. R. SIM.

12th December, 1904.

CONTENTS.

1. Introduction.
2. The raising of young trees from seed.
3. Propagation of trees by means of cuttings.
4. The planting of trees.
5. The care of plantations.
6. Principles of sylviculture.
7. Treeplanting in the Upper Districts of Natal.
8. Treeplanting in the Midlands.
9. Treeplanting in the Coast Districts.
10. Treeplanting in Zululand.
11. Cultivation of Black Wattle (Acacia mollissima).
12. Cultivation of other Acacias.
13. Blue Gum (Eucalyptus Globulus).
14. Cultivation of Eucalypts.
15. Araucarias.
16. Pine trees.
17. Trees producing Cedar and Cypress woods.
18. Deciduous Trees.
19. Miscellaneous Trees.
20. Indigenous Trees.
21. Urban and Suburban Arboriculture.
22. Ornamental Trees and Shrubs.
23. Hedges and Shelter Belts.
24. Horticulture.
25. Sand Dune Reclamation.
26. Government action in Treeplanting.
27. Index.

Tree-Planting in Natal.

CHAPTER I.

Introduction.

Natal enjoys to be styled "The Garden Colony." The title is not inappropriate, especially in the lower half of the Colony, where Nature has been lavish in her gifts of soil, climate, rainfall and vegetation, where natural bush luxuriates in small scattered park-like clumps, and where even exotics thrive and naturalise themselves, to the evident enhancement of the landscape.

The whole of the coast district is one vast natural landscape garden, the midlands consist of a frequent alternation of forest and veldt, and even in the upper districts berg forests are usually visible though the nearer view may be somewhat flat and bleak. These varying scenes, together with the farm cultivation and native mealie-gardens throughout the Colony, and more especially the pine-apple and citrus orchards from Durban to Pinetown and along the north coast, warrant the use of the popular appellation.

But, apart from mealie-gardens and coolie gardens, the very title "garden" implies the artificial cultivation of trees, shrubs and flowers, whether exotic or indigenous, and one cannot go far, especially in lower Natal, without being struck by the extraordinary variety of vegetation now extant, and mostly in good healthy condition. This applies more particularly to the tree vegetation, species of the most diverse appearance and nature flourishing together in profuse luxuriance, while exotics from Europe, Asia, America, Australia, and also from other parts of Africa stand side by side and seem equally at home, alike on the coast and in the midlands. Natal is, in fact, a tree-planter's paradise, in which, with reasonable selection of species and site, and a minimum of attention, success is practically assured. But it is this very fact which frequently leads to disaster. The exuberance of nature is trusted as all-

powerful, reasonable selection of species and site is overlooked, and even the necessary minimum of attention is not given: then when the trees inevitably die everything is blamed except the carelessness of the planter, the real cause of the trouble.

There is no excuse for this. A commercial plantation does not pay dividends through unskilled initiation, negligent management, nor parsimonious economy; a shelter belt is not a shelter belt when gaps occur, nor is an ornamental garden ornamental when specimen trees stand ruined either through over-crowding or through being planted in unsuitable sites. Trees vary in their constitutions and in their requirements; each tree has to be fully known and so has its site, before success can be assured, or reasonably expected, and even then unlooked for circumstances occasionally interfere. The average householder has neither opportunity nor inclination to hunt up the characteristics of each available kind on purpose to select the dozen or score of trees which he proposes to plant in his own erf, especially if that information is scattered through numerous tomes of foreign literature. It is on purpose to make such information easily accessible, applicable to local conditions, and supported by local evidence, that the present brochure has been written.

But, besides the purely esthetic, there is an equally important commercial aspect of this subject.

Natal is not, never has been, and never can be, an over-sea timber exporting country. The indigenous forests are unable to meet the domestic requirements of the Colony; they have constantly decreased rather than increased, and as they are in great measure in private ownership this is likely to continue.

Even the enormous imports of foreign timber which have arrived during recent years have done little towards saving what remains of the forests; the Colony and its hinterland have developed with corresponding rapidity, fresh demands have arisen, and the only salvation for the indigenous timber is the fact that it is not standing in the forest already planed and grooved as the imported material arrives.

Before the advent of the railway the indigenous forests supplied whatever was required of timber for every purpose, not only within Natal but also in the Orange River Colony and the Transvaal, neither of which had much in the way of forests of their own. The railway and improved landing facilities altered that, and now hardly a train passes up-country which is not loaded in good part with imported timber. The following table indicates what is being received at Durban. Of course this is not all for use in Natal; much of it passes to the Colonies beyond, but the fact remains that there is a demand for that amount of material which could mostly be as well grown in Natal as imported through it. Not only is that the case, but there is a further huge importation of timber through Delagoa Bay into the Transvaal, necessary to meet the demand there.

TIMBER IMPORTS INTO NATAL, 1896—1903.

AS SHEWN IN THE CUSTOMS RETURNS.

	Year.	Deals & Timber, Unmanufactured.		Boards and Planks.		Manufactured Goods, including Sleepers, Boats, Cars, Houses & Frames, Woodware & Corks, but not Furniture, Wagons, Carriages, or Barrels.	Total Value.
		Cubic feet.	Value.	Cubic feet.	Value.		
			£		£	£	£
	1896	5,470,290	221,164	1,761,272	91,077	65,140	377,381
	1897	4,186,492	173,015	1,394,283	76,341	60,151	309,507
Affected by the War.	1898	1,687,052	85,055	1,152,422	74,920	41,418	201,393
	1899	1,378,829	59,987	916,655	56,733	45,895	216,613
	Govt. imports		1,616		1,755	50,627	
	1900	1,465,082	58,307	552,948	34,724	26,944	139,714
	Govt. imports		4,786		639	14,314	
	1901	2,518,009	151,390	757,336	55,998	53,751	270,080
	Govt. imports		3,235		549	5,157	
	1902	3,143,402	182,005	2,037,687	124,475	81,560	396,723
	Govt. imports		2,286		25	6,372	
	1903	2,518,009	151,390	757,336	55,998	56,372	270,080
			3,235		549	2,536	
	Total for eight years ...						£2,181,491
	Annual average for eight years ...						£272,686

When one takes into consideration the destructive felling which is taking place in many timber-producing countries, the increasing scarcity of timber, especially in large sizes, the consequent rise of price which though gradual is constant, and the probability of a timber famine in most civilised countries at a comparatively early date, he cannot but be struck with the necessity for making some local provision against the day when all timber-importing countries may find themselves practically cut off from supply, and when, even for local consumption each Colony will have to depend on its own resources, or pay heavily for its import.

At the present time each South African Colony is doing something toward making, by Government effort, some such endeavour. In the Cape Colony such Government afforestation has been carried on for a good many years and is constantly increasing and becoming better understood and consequently more successful; in the Orange River Colony, Transvaal, Rhodesia and Natal the comencement has only been made during the past two years, advantage being taken of the experience gained in Cape Colony as well as what may be learned from private planting, in which, however, ornament rather than utility has usually been the first consideration.

Extensive afforestation is generally regarded as a business belonging to the State rather than to the individual; it requires such a long period to intervene between the initial expenditure and the final harvesting, and then only gives a comparatively small return for money invested, that the individual or even the company is to be excused from not readily taking it up. But ideas with regard to this have been formed from European experience and from European text-books; South African conditions and South African climate are altogether different and already it has been the experience of many that what was planted for ornament has proved a source of very considerable income, and what was planted for profit has proved very profitable indeed. Of course there are also in Natal plantations many cases in which disappointment has come in, but where practically everything was done amateur-fashion it would have been surprising indeed if mistakes in regard to kinds, soils, situation, espacement, thinning or reaping had not come in. These were all the more likely to occur on account of the great differences in altitude and general exposure as well as humidity, which occur, not only in Natal but throughout South Africa.

Natal has proved that in at least one forest industry—that of Black Wattle,—private planters can, by due care, make reasonable fortunes within one decade, reaping returns on expenditure probably unequalled in forestry elsewhere, and with this other peculiarity that the private plantations of this one species in Natal equal not less than one-fourth the area of the renowned Government Plantations of India of all species.

Already it has been amply proved that with due selection of kinds and soils even the high veldt of the Transvaal can grow trees in variety, rapidly and successfully. This fact has to be remembered in connection with afforestation of Natal, for timber is such a bulky and heavy product, that the nearer to its market it can be grown, so much the greater is the profit. The Transvaal as a future market then can be estimated in accordance with how much the Transvaal plants, but there is no probability of its meeting its own demand for many years to come, and so long as it continues to import timber so long has Natal a sure market if the material can be supplied.

The Transvaal is not, however, Natal's only outlet for timber (not yet planted). The demand within Natal, and which cannot be supplied meantime except from oversea, is very considerable, and with closer settlement and progressive industry is bound to increase enormously.

Griqualand East, Pondoland and Zululand naturally and necessarily draw their supplies from Natal or its ports, and with the railway development now in hand the Orange River Colony, Kimberley, Bechuanaland and Rhodesia all come to be as well served from Natal as elsewhere.

Government cannot and will not in one or a few years make provision for all the future timber requirements of Natal as well as of those parts of its back-country in which timber cannot be successfully grown, so for many years to come the private planter need have no fear that he will not have an outlet for proper material, or that the afforestation practised by this or any other Government will unduly interfere with his market.

There is a demand for rough props as well as for clean-grown timber, only in either case the work has to be treated in business fashion, and it does not do, as happened recently, for a purchaser (Natal Government in this case) to have to send to Australia for rough piles because the local contractor would not deliver rapidly enough, material of which there is quantity going to waste locally.

In every detail, from sowing the seed to reaping the harvest, the man who knows his subject has the advantage, and whether it be for ornament, shelter, pleasure or profit the planting of trees repays him best who takes the trouble to ascertain beforehand what results he should expect, and how to obtain these. Perhaps in nothing is this more evident than in the Black Wattle industry, in which a few producers, by securing a suitable combination of geographical, geological and climatic conditions, have been able to realise, with little additional cost, a much greater return from wattle timber than from wattle bark, and the highest price for both, while the average grower, satisfied with the conditions he had, finds on maturity that his timber is unsaleable, and his bark subject to undue costs of protection, cartage, or freight. The full import of this is only now being realised, and even to-day plantations are being put down which have a doubtful prospect before them, while others anticipate with certainty a financial return surpassing anything yet reached.

The same necessity for care applies to commercial plantations of any kind, for in all timber ventures the weight of the product and the length of time it takes to mature renders sound but economical initial work an absolute necessity.

Even after the initial stage is passed, and when, in the ordinary course plantations are left to look after themselves, this care is still as necessary, and its absence often shows unexpected and woeful results when it is too late to mend matters. Liability to fire occurs under certain conditions, a tendency to undue development of branches and consequent production of knots follows early sparseness, while lanky and undeveloped whipsticks result from neglect of the precept to thin often and lightly throughout the life of a plantation.

It is difficult to get owners to plant close enough; it is just as difficult to get them to harden their hearts and thin out at the right stage for the benefit of those left, and it is even more difficult to get them to cull out the wastrels and leave the best when thinning is undertaken.

And, at maturity, it is just as necessary to keep a watchful eye. Again to use the Black Wattle industry as an example because there is a possibility of a drop of 5s. per ton in the bark market, or chance of an equal rise in freight, an owner is tempted to rush an undue proportion of his plantation into one season's felling, and being short of labour strips more than he can dry well, or fells more than he can sell the timber of.

At every stage in timber growing, business ability and a knowledge of the subject give a prospect of reasonable, if not high profit, while the absence of these often leads to disaster.

It must also be noted that a first-rate landscape gardener is not necessarily a competent forester, and *vice versa.* The aims and methods of the two vocations are altogether dissimilar, and beyond the fact that each lives on tree-culture, they have little in common. Commercial timber is not produced by fine, spreading, ornamental trees, nor does a commercial plantation produce an ornamental effect except in the mass. A plantation must be either the one or the other; any attempt at combination is usually a failure.

It does not follow either that a first-rate European forester will be a success here. If he can unlearn his past training rapidly and adapt himself and his work to his new conditions and surroundings he may succeed, but he has both to do of necessity.

The fundamental principles are the same all the world over, but the application of them varies under local conditions and this variation must be met. Hence the unreliability of European text-books under South African conditions; even the behaviour of the numerous species can hardly be predicted from their well-known behaviour elsewhere. Success under similar climatic and thermal conditions is the safest guide when dealing with unknown exotics, but even these conditions are not always reliably ascertained or gauged, especially if local, and may lead astray.

For instance it is common practice to regard South African conditions as more or less alike wherever the rainfall is equal, but the tree-planter has to face the enormous difference between a wet summer and a dry winter in the east and a wet winter and dry summer in the west, a difference so telling that it practically excludes the kinds successful in the one from being so in the other, except possessed of a most elastic constitution. Even the indigenous kinds vary very considerably from east to west, and not less so under much more local variations of soil, aspect, rainfall, and temperature. Indeed, in practical sylviculture the indigenous kinds have not proved successful, the conditions suitable for their growth being so exceedingly local and rigid, and the growth under these conditions so slow, that exotics have entirely displaced them from culture. When that is so with regard to the whole of the indigenous species there is nothing surprising in many of the introduced exotics proving,

sooner or later, that conditions here do not fit them. It is rather a matter of surprise that so many species have been found sufficiently elastic in their constitutions to allow them to endure local conditions differing considerably from those natural to them, and ranging in some cases from the coast to the berg or even beyond.

In many cases it has been demonstrated that single specimens of certain kinds can do well, but it does not follow from that that a whole forest of the same kind, on forestal lines, will do equally well; indeed in almost all kinds single specimens have been more successful in health and vigour than forest clumps of the same species, probably owing to our not yet having fully appreciated the various requirements in forest culture. In Natal that branch of forestry has not yet passed through a whole life-course of any species except Black Wattle, and there are consequently fresh developments constantly coming in; indeed, throughout South Africa those who know most on this subject realise most how much they have yet to learn. There is no reason, however, on that account, to postpone the formation of plantations until nothing more has to be learned; it has taken at least three centuries to reach the stage now attained in Europe, and if proportionate delay is necessary here, then the first plantations will have passed through several rotations, and the first planters will long ere then have reaped returns proportionate to the relative success they have achieved and the failures they have avoided, rather than graded from all-round success.

The economic advantage to the Colony in growing its own timber, or to the individual in assisting to do so, is not confined to preventing money going out of the Colony for the importation of timber. That in itself is an enormous advantage; if our timber import were supplied locally there would be the value—approximately £300,000 per annum—in circulation here which now goes abroad. But that means a great deal more than simply passing that amount into the hands of the land owners. An additional population of practically that value is required for the production and handling of the timber, these in their turn require the attention of storekeepers and producers in other lines, and the closer settlement of Natal is thereby effected, working on land meantime considered unfit for agriculture, and still rather requiring an increase of local agricultural production than competing for what produce market now exists.

Local production of timber may also affect the cost of living. Mr. Hutchins thus states the position with regard to Cape Colony, and the same holds good in Natal:—"The settlement of the forest question is necessary to give people homes at a moderate cost. It is hardly second to irrigation and railways. The extraordinary dearness of timber here is the chief factor in the high cost of living. Labour is high because house rents are

high, and house rents are high because labour is high and wood expensive; so that cheap timber has a double action on the cost of living. It is easy to show that the production here of the seven million cubic feet now imported would lower the cost of timber by one-half, and at the same time leave a large margin of profit to the State."

Timber production has also a marked effect upon the climate, but that effect is often mis-construed and exaggerated. As in other matters, European experience may mislead here, unless due allowance is made for conditions non-existent there. The effect produced by trees lowering the temperature alike of the soil and of the atmosphere under them, especially if the trees are in mass and evergreen, is well known. The higher the temperature the greater is the reduction effected by tree-shade. The atmosphere carries at a high temperature an amount of moisture which it is unable to carry at a low temperature, and consequently when a warm coastwind comes in contact with a forest atmosphere of considerably lower temperature its moisture precipitates as rain, or at least adheres as dew to every cold leaf. Forests therefore cause rain or mist, and mists help forests, the effect being a reflex action on each. Thus far, European and South African experience coincides. But vigorous growth means increased absorption of moisture from the soil. In South Africa vigorous growth is enormous as compared with that in Europe, while, generally speaking, the rainfall is not greater and the amount of dew less. The general evaporation is, however, much greater, especially in inland and elevated localities, the transpiration is much greater everywhere, and in actual practice it is found that several species in use here have the habit, while growing actively, of requiring more moisture than the total precipitation of the locality. When this happens and becomes continuous, gradual drying out is inevitable, and in many localities Eucalypts and Acacias which are quite vigorous while young, dry out the soil, and suffer or die before maturity is reached. Slower-growing trees, however, especially slow-growing pines and conifers, and indigenous forests, have the opposite effect, condensing more moisture than tney absorb, and storing it in the humus produced on the soil-surface by their fallen leaves. It does not follow that because streams have ceased to run where they used to run, that trees higher up have dried out the country, but it does often happen where such cessation occurs that the humus formed under the trees has commenced to retain for local use, whatever moisture falls. If, however, such cessation occurs along with a bark-bound or unhealthy condition of the trees, it may safely be assumed that the absorption is greater than can be maintained, and that the crop will pay better to harvest then than to leave. From the above it will be seen that the assertion that extensive tree-planting increases the rainfall of a country may, with certain trees

and under certain conditions, be absolutely true without producing enough rainfall to keep the trees alive, but that with certain other kinds the effect is productive of much good, not only within the forest but throughout the neighbourhood. Taken as a whole Natal has, thus far, shown a preference for kinds having a drying out tendency, but the main demand in importation is for timbers of the class beneficial climatically, and in every respect the extensive culture of these deserves encouragement.

Africa as a whole has shown a marked advance of desiccation during the past twenty years; the karroo has extended outward in marked fashion at every point, and even Natal contains many places, which, with a continuance of dry conditions, would lapse into carroid veldt if not into actual karroo in a few years. The planting of Eucalyptus and Acacias, however useful in other respects, does nothing towards checking this drying out; the planting of pines and the maintenance of the indigenous forest, on the other hand, if of sufficient extent, do have a distinct effect in this direction.

The destruction of bush in the coast district to make way for Coolie gardens of low grade and short tenure, is truly lamentable, but, being on private land, can hardly be checked. But, where such clearance is constantly going on there is every necessity for an equal amount of cool forest being planted year by year, either in worked out sugar lands or in worked out mealie gardens, to maintain or improve the balance of nature.

In the mist belts, the effect of trees in arresting and taking advantage of moisture which otherwise would blow past is enormous, and even the grass does duty in this direction. Dr. Marloth records some experiments he made on the top of Table Mountain, Cape Town, by placing two 5-inch rain gauges in proximity, one being left open in the usual way, and the other surmounted by a wire frame-work containing a bunch of reeds a foot high. From December 21, 1902, to February 15, 1903—the rainless season there, but misty on the mountain-top—the ordinary gauge registered 4.97 inches, while the gauge with reeds registered 78.84 inches, besides having overflowed on several occasions. He says:—"It is not too much to assume that, as the season of the southeast clouds extends over double that time, there would consequently be a condensation of moisture, exclusive of all rain, of at least 150 inches during the summer alone." After that, who will burn off his grass and then complain of shortage in moisture? Truly, in such mist "every blade of grass has its own drop of dew."

On a misty day anywhere in the Natal mist-belts the roads will be found quite wet with drip where overhung by trees, even wattle trees, while the adjoining portions of the road are not in the least wet.

It is not, however, every tree-planter who is interested in questions of colonial forest policy, mercantile tree-planting, climatic influences, or general effect; many an one is more inter-

ested in his own front garden than in all the 'timber factories' planted throughout Natal, and prepared to give a higher price for a seedling exotic than for a full-grown yellow-wood. To such, the best advice is 'study well the gardens of your neighbourhood, learn from your neighbour's successes and failures, but be not surprised if your own experience does not coincide with his.' Trees have a knack of looking happy when they are in luck, whether that come from careful management or pure accident, and cases are not uncommon in which one specimen of a species does well while another in the same garden, and apparently under the same conditions, fails to flourish, without evident reason. In this, as in commercial tree-planting , the more the planter understands the science and details of tree-planting, and the peculiarities of species, the more likely is he to succeed.

In private landscape gardening quite as much as in forest planting is it necessary to adhere to the principle of planting closely and thinning often. Of course it is not necessary to plant so closely for scenic effect as for clean timber, but if trees stand at first at the distance apart which is ultimately required, they look very sparse indeed when young, and fail to have much effect for several years. But it is necessary, all the same, to have the ultimate trees selected first and placed on the plan, if not in the ground, before further action is taken. Then, after these are decided on, other kinds, not necesarily of the same value can be introduced for filling up, but destined for removal before they reach the stage of interfering in any way with the permanent trees. The latter should, so far as possible, be kept perfect specimens of their respective kinds, the roots having sufficient room for development, the branches spreading widely and retaining their foliage to the ground, and the espacement and placing being such that all eyesores are hid, while on every hand delightful glimpses of distant scenery can be seen as accidental vistas through aparently informal planting.

A small garden does not lend itself to much of this, so the owner must be content with a modified plan which may consist of one or more specimen trees forming the main attraction, and supported only by grass or vegetables, or, the specimen trees may be omitted and their place taken by a hedge or belt of shrubery near the boundary, so arranged as to give privacy within the enclosure and at the same time allow whatever is most attractive in the scene beyond to be seen. The changes which can be rung on these two designs are very numerous, for there is hardly a tree in existence which will not make an ornamental specimen tree if given a fair chance in a suitable place, and there are few trees which do not also lend themselves to massing for boundary work. Even fruit trees may be employed as successfully as other kinds for either purpose, for there is probably no finer specimen tree than a healthy and

well-grown Loquat, and few more ornamental than a full-grown Orange draped in fruit.

The kinds to be employed necessarily vary with the locality where they are to be used, for there is sufficient variation in the climate and character of the different localities in Natal to prevent the general use of many kinds. It is true that many hardy species can exist almost throughout Natal alike in the midlands, coast district, and berg, but even where this does occur there are limits within which each species is at its best, and beyond these limits the culture of that kind either for ornament or utility can hardly be expected to be satisfactory.

The tropical and sub-tropical kinds, on the other hand hardly extend beyond the reach of coast influence except in occasional very favoured localities. There are also constant endeavours being made to introduce, re-introduce, or cultivate, kinds which belong to colder or more tropical regions or regions favoured with greater winter rainfall or more free from the hot winds which occur occasionally in Natal. Such attempts can hardly be expected to succeed, and as a matter of experience seldom do succeed, and in this way a large number of species, favourites in other countries have to be excluded from our list. The Horse-chestnut, Æsculus hippocastanum; the Lime, Tilia europea; the Beech, Fagus silvatica; the Norway Spruce, Pinus picea; the Silver Fir, Pinus abies, must all be included in this list, while several others, including Pinus excelsa, Pinus strobus, Pinus sylvestris (Scotch Pine), Catalpa bigonioides, Larix europea (Larch), Eucalyptus marginata (Jarrah), Ginkgo biloba (Salisburia adiantifolia), etc., though often tried, have never yet proved quite satisfactory.

Numerous species, probably quite suitable for culture here have not yet been attempted, through difficulty in procuring seed. These include whatever may be available and suitable from Mexico, Central and South America, as well as further additions from China and Japan.

Australia meantime contributes largely to our exotic flora, but with regard to Australia as well as South Africa we are too apt to accept the whole flora as of one nature, and overlook that that island-continent includes immense variation of season, rainfall, temperature, elevation, latitude, etc. This variation shows, however, in the trees obtained from it, some of which find conditions more congenial here than even those of their native habitats, and thrive accordingly, while others do not find their requirements met here, and sooner or later die out.

The trees of New Zealand, numerous and important as they are in their own country, hardly enter at all into our exotic forest flora, only a few localities, right in the mist-belt being sufficiently moist to suit their requirements. So

also with Indian trees, the valuable species which are not too tropical requiring either more rain or more snow than they can obtain here, while those of China and Japan best known to us have peculiarities of environment not easily met. Trees from the Mediterranean region are accustomed to a winter rainfall and their culture has to depend upon the elasticity of nature of each species as to whether it will succeed or not.

With regard to deciduous trees, since the indigenous forest-trees are almost all evergreens it may be assumed that Nature did not intend this as a country for leaf-shedders; there are, however, a few such among the native trees, while the exotic hardy fruit trees almost all belong to this class and are still successful. The difficulty with them is that they can only be planted when leafless, and consequently require to be planted when the ground is hard and dry and when artificial watering has to be maintained for some months. There is also a danger, not confined to the first year, of their coming into leaf too early, and suffering from the effects of a late frost. In fruit trees this takes the form of injury to the blossom, but in forest and ornamental trees it is usually the foliage which is affected, Oaks, Elms, and Planes being liable to suffer in this way. Wherever frost is experienced sufficiently severe to do injury it is noticed that a combination of drought and frost is much more dangerous than an equally low temperature under moist conditions, and frequently damage is attributed to frost which actually is caused by drought or the two combined.

Where irrigation can be practised it may be possible to ward off the effects of frost on dry trees by its use.

The other troubles, besides climatic unsuitability, drought and frost, by which forest and ornamental trees are afflicted are not often the cause of serious injury. Fruit trees, of course, have their animal and vegetable pests in abundance, doing damage alike to the health of the tree and the condition of the fruit, but among forest trees, though often present, these pests have in only a few cases caused serious injury in Natal. Elsewhere, even with the same species, more serious damage has been done, but here the vigour of well acclimatised species is often sufficient to carry them through the trial till one or other of Nature's remedies or preventives interferes and kills out the pest or keeps it in check. The forestal scientific treatment where there is danger of such attack is to have a number of species so interspersed that any trouble is less likely to spread on one species than if the trees were in juxta-position, and this is practised in Europe where the requirements of each species are thoroughly understood, but here the mixing of species is admittedly only in the experimental stage, and more damage has been done on several occasions by unsatisfactory mixtures than was likely to have been done by pests on pure planting of one species. Where naturalisation is unsatisfactory pests

must always be expected to cause trouble, for an unhealthy tree of whatever species, is more liable to be afflicted in this way than a healthy one, and sometimes the pest gets the blame for the tree's condition, where the former is rather an effect.

In ornamental sylviculture trees are naturally scattered and healthy, whereas in forest-planting the closer espacement, requiring to a certain extent the survival of the fittest, gives pests an opportunity which fortunately has not been largely taken advantage of here. Black Wattle has, however, sometime suffered severely form Bag-worm, caterpillars, and locusts; Pinus insignis, Oaks and Willows suffer from caterpillars, and Araucarias, Blackwoods, and various other trees are sometimes attacked by scale. When the trees are a few years old, however, their size renders curative treatment impracticable, and the moral therefore, is to see that clean trees only are planted, and so avoid the first infection from which further trouble springs. Since most of the trees used are raised from seeds and kept only a few months in the nursery the chance of infection there is small as compared with that of fruit trees, which often spend several years in the nursery under conditions which sometimes render infection easy. With forest trees it is also practicable to raise seedlings on the farm on which they are to be planted, and thereby reduce the risk of infection to a minimum. It is undoubtedly this practice of raising forest trees from seeds which has left Africa thus far clear of most of the pests which affect Eucalyptus and Acacias in Australia or the Pines and Oaks in Europe.

But the very fact of having to raise trees from seed, under methods and with appliances suitable for this Colony, is one of the principal reasons for the publication of this bulletin, so much of the work being different from ordinary agriculture, horticulture or even sylviculture as practised elsewhere, that even experts are apt to make mistakes before they appreciate local conditions and influences, while those familiar with these are often less intimate with the life histories of the various species of trees, and the uses to which these trees are put elsewhere. In planting trees on a commercial scale which may take half a century to mature it is necessary at the start to know that these trees, when mature, will actually have a value for some certain purpose, and that that value may then be realised in cash. And in planting even for shelter or ornament it is always advisable to use kinds which, grown in that fashion, can be of use for props or piles or some other such purpose, when no longer wanted on the farm.

Much disappointment has been produced in Natal through the wide-spread growth of Blue Gum (E. globulus) in quantities too small to be worth gear and appliances for moving the heavy

logs when fit for felling, while at any other stage except maturity the demand is low and the value small. Considerable disappointment has also resulted through accepting, without any allowance, the local Australian valuation of each species. It must not be overlooked that such valuation is usually based on experience with trees found mature in the bush, of unknown age, and selected for the purpose in hand. In that case bad trees, twisted trees and knotty trees are avoided, the best only are utilised, and these only in so far as suitable.

Each Colony has a certain interest and pride in advertising its own wares as the best in existence for any and every purpose. Probably each believes that it actually has the best, because within its own boundary it knows no better, and has little experience of any other, except softwood imported from Europe. But when they come into competition in an outside state, the comparative values and durability, not only of selected logs but of timber as it comes, is more noticeable, and it is then found that some which have a reputation for durability are only durable as compared with kinds which are less durable, but are themselves less durable than others hardly on the market because they come from where a still better is easily procurable. And, again, in any one species it is evident that the quality is not always reliable. This can be seen even among our indigenous trees, for sometimes an old Yellowwood can be found with heartwood as hard as Sneezewood, while the outer wood of the same tree is soft and perishable; and that, too, in a species which usually does not differentiate between heartwood and sap-wood. Among Eucalypts as well as other trees, not only the age of the tree but also the ground it has grown in affects its quality.

All local experience of exotics is naturally founded on a comparatively short period; there are probably no Eucalypts and few other introduced trees in Natal more than 50 years of age, and only on a few places do they exceed 40 years. These earlier trees, planted when transplants were scarce and expensive, were naturally planted at wide espacement and consequently have branched much and become of low technical value, so it is unfair to form any estimate as to what any species can do under correct treatment from what these trees have done under the treatment given. Still the Colony is deeply indebted to those earlier planters, and to the Botanic Gardens and nurseries which, long ago, sowed the seeds or planted or distributed the trees from which all Natal experience of the comparative ability of the different species to stand local conditions is now obtainable. Particularly does the Botanic Garden of Durban claim attention as the local habitat and centre of distribution of many fine exotics which are, even now, insufficiently known. The necessity for numerous test grounds distributed throughout

the Colony is however, amply demonstrated by a closer examination of what that garden has, and has had, for, especially in Eucalypts, the species which thrive throughout the Colony are now conspicuous rather by their absence than by their successful presence, and the same holds good with regard to Wattles and Pines.

It is not to be inferred from this that these species will sooner or later succumb throughout the Colony, but rather that the sub-tropical coast conditions of Durban do not represent the average tree-planting area of the Colony, and that Durban experience must be accepted as local to the coast rather than ht for general application. Even in that it is doubtful if the climate of the Berea sufficiently represents the possibilities of the malarial region of Zululand and Maputaland; a region where afforestation is still in its first experimental stages, but where it may be expected in future to play a large part both in climatic improvement and in industrial development,

Near Maritzburg, the Maritzburg Botanic Garden, the Alexandra Park, the arboretum formed by the late Mr. Wilkinson at his Nursery, and trees planted by the late Mr. Henderson on the Town Hill and at Hilton, and by others in the same neighbourhood all show the behaviour of many species under reasonably good conditions, while other plantations and gardens such as those of Mr. R. Topham, Mr. Blackborrow, etc., show these same species under conditions of soil and aspect which are seldom satisfactory and in some parts very unsuitable.

Numerous other plantations could be mentioned, at Nel's Rust, Richmond, Harding, Centocow, Ravensworth, Greytown, and along the Karkloof, where experimental planting has long been carried on and where present planters can benefit by the experience thus gained.

In the upper districts successful plantations are fewer and of less age, the result partly of climate, partly of later settlement, partly of the difficulty and cost of transport of transplants before the railway was formed, and partly of the aspect and conformation of the country which is less suitable for tree-culture than that below the high midland range, though not so bad as to prevent success coming in in well-selected places. For up-country trade purposes the mileage saved in the transport of timber by the formation of plantations near the borders of the Transvaal and Orange River Colony is worth consideration, especially as there are large areas close under the Drakensberg which have once been under timber and would not be difficult to afforest again; these are practically all in private ownership and consequently have a mileage premium over any-

thing that the Government may plant in lower and more remote localities.

One important item in forest-planting is to have a sufficiently large area planted at one place to be ultimately worth a railway, a saw mill plant, and if the plantation is of Pine trees a creosoting plant. Small plantations cost more per acre, (including fencing, management, afforestation, protection, and harvesting), than large ones, the danger of fire is greater because of more boundary exposed, in relation to the total area, and the danger is also greater of interest in the plantation dying out through change of ownership, than if a considerable initial expenditure and a large anticipated revenue is involved. But of even more importance than this is the fact that where a large plantation is being put down on commercial lines sylvicultural principles are or ought to be duly considered before a start is made, whereas in laying down small plantations each owner follows his own fancy without much inquiry as to whether or not there are any principles involved.

Natal-grown timber takes practically no part in technical construction at the present time for various reasons. The indigenous Crown forests are remote and meantime more or less inaccessible; the indigenous private forests, where accessible, have been heavily worked in the past, and are now worked only for Yellowwood and Wagon-wood, for which there exists a limited demand, while the plantations of exotics are, with the exception of Blue Gum (Euc. globulus), mostly too small and too young to be felt at all as a factor in commercial enterprise. Absolutely no coniferous timber is available to take the place of the imported deal, and until the local product of this nature is at least equal in amount to that imported, the latter must rule the market alike as to price, and manner of marketing.

Natal is meantime putting down Crown plantations with a view eventually to meet the demand of this nature, but it is also putting down fresh wharfage to meet the requirements of the timber importation trade, and retain the timber transport until local material begins to be ready, which cannot be for a good many years yet.

Nine-tenths of the timber requirement of most countries is for soft coniferous wood, or would be so if that timber were available, even Australia while pushing an export hardwood trade, being a heavy buyer of soft woods. From interesting articles in the Queensland *Agricultural Journal* for July, 1904, it appears that the imports into Australia of timber, which could have been grown in the Commonwealth, reached the value, during the last three years, of an average of £1,084,000, while its total

oversea timber exports valued last year only £753,602, of which £595,077 went from Western Australia. It is pathetically remarked "It will be a truly remarkable thing if, when we have destroyed our forests within payable haulage distance of our railway lines, we find it cheaper to import plantation Eucalyptus timber from Durban or Delagoa Bay than to haul our own inaccessible timber. The contingency is not really as remote as it may look. We have already reached the absurd point of importing into Sydney from Natal quantities of New South Wales wattle bark grown in South Africa."

In so far as the Natal import is not coniferous it is almost entirely composed of Australian hardwoods, mostly for sleeper purposes, and the above quotation supports other testimony that that supply may not last for long. How far we are dependent on these Australian hardwoods is shown by the following particulars, kindly supplied by the General Manager of Railways.

SLEEPERS IMPORTED FOR USE ON NATAL RAILWAYS DURING FIVE YEARS,

JANUARY, 1898 to DECEMBER, 1902.

Sleepers for open Lines.	Sleepers for Construction Department.		Crossing Timbers, or Cr ossing leepers, Karri, Jarrah, and Djatti & Pitch Pine, raw and creosoted.	Usual Size.	Average Price.
Karri, Jarrah, and Djatti.	Karri, Jarrah, and Djatti.	Baltic Pine Sleepers, creosoted.			
Natal Gov	ernment	Railw'ys			
716,418	170,000	118,637		7' 3" x9" x 4½"	4/6 each.
			36,445	7' to 20'x 10" x 5"	11d. per lineal foot
Zululand	Railway				
		20,000		6' 9" x 9" x 4½"	4/10 each
		174,000		7' 3" x 9" x 4½"	4/6 each
			27,392	7' 3" x 10" x 5"	6/11 each

This represents during the five years a value of over £300,000, or say £60,000 per annum for sleepers and crossing timbers alone, and of this amount nearly three-fourths is for Australian hardwoods, which, in time, could be supplied by

Natal-grown Eucalypts. The balance, as well as almost the whole of the remaining timber import could in time also be supplied by Natal-grown conifers. To do this, however, it is necessary that all extensive planters act systematically, using kinds of known value,handling these by the best methods, planting sufficient quantity to be worth attention till mature, and treating these as a forest crop instead of as a by-product.

CHAPTER II.

THE RAISING OF YOUNG TREES FROM SEED.

Raising trees from seed is an exceedingly simple matter; so simple, indeed, that most people consider they know all about it by intuition; and yet, somehow, mistakes occasionally creep in, and it often happens that a large packet of seeds gives only a small number of plants.

The essentials to success are fresh seeds, common sense and constant care; without these no instructions will meet every case. The habit of growth and the individual requirements of any species must be taken into account in dealing with it, and as these vary considerably in different kinds, a uniform practice cannot be expected to succeed.

Fresh Seeds.—Fresh seed does not necessarily mean freshly-collected seed; it may rather be described as seed in condition for growing with no further preparation than is usually necessary for the kind. Most kinds are best when newly collected, some keep fresh for a few months, others for a few years, and a few kinds keep good for many years, but in each case the duration of vitality depends on the treatment given. Thus, acorns collected from the trees into a bag, and left for a few days in the sack undisturbed or sent on a journey to another place, will usually heat to such an extent as to destroy germination; whereas, these same acorns spread out for a few days till they have sweated, may afterwards be bagged or stored with much less danger, though if left lying singly on the ground they do not long remain fresh. Berries of Pepper tree (*schinus molle*) heat in a few hours if put in bulk when freshly pulled, but keep for months if spread out for the first few days. Almost any hard dry seed keeps best if stored quite dry, while soft or sappy seeds seldom keep well, and should usually be sown as soon as obtained. Moist humid conditions are the worst; in these the seeds usually sprout or ferment earlier even than is natural to them, and seeds which smell musty through dampness should never be fully relied upon though only recently collected.

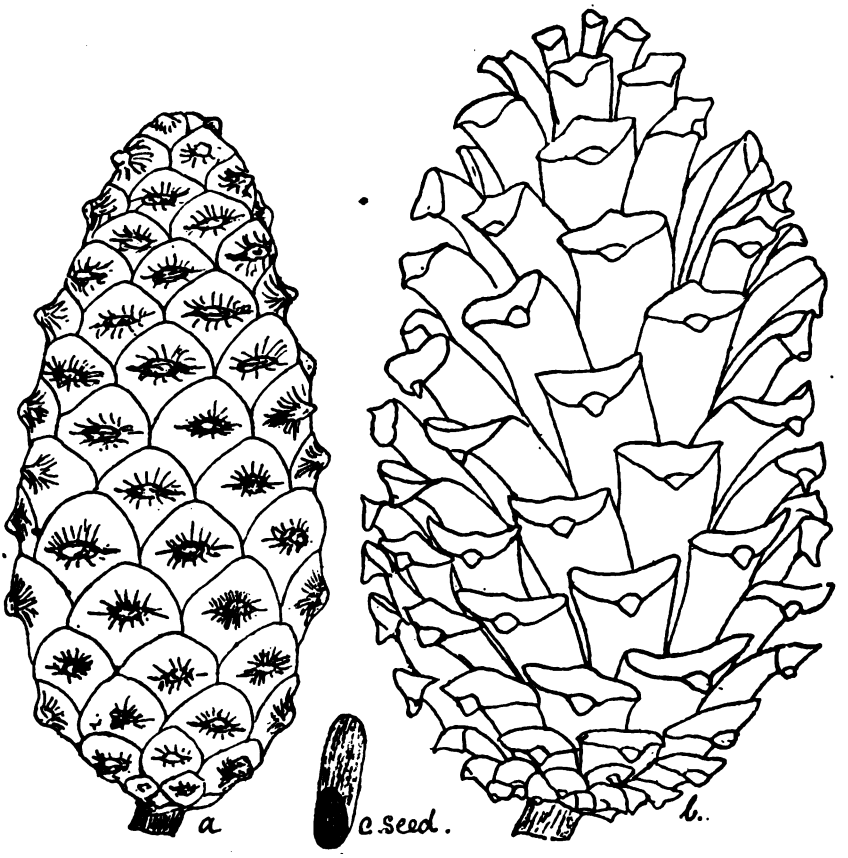
Collecting Seed.—Most growers on a small scale purchase from seedsmen what they require, and in this way they can easily obtain varieties which otherwise might be unobtainable. They have then the consolation of blaming the seedsman for supplying old or bad seeds if through any mismanagement on their own part the seeds fail to germinate, as often happens, even with the best of seeds. Freshness can, however, be insured by the grower collecting fully ripe seeds for his own use, where such are obtainable, and giving the necessary care to dry them sufficiently, for it must be remembered that tree

seeds are just like wheat or oat seeds, which require to be harvested before they fall, and yet must be dried for a time before they are fit to thresh and store. Usually it is best to collect from the tree rather than pick up fallen seeds, and almost invariably it is cheaper to do so. A few kinds, including Silk Oak (*Grevillea robusta*) and Sneezewood (*Ptaeroxylon utile*), which have elastic seed-vessels that burst open and shed the seeds on any very bright hot day, even before the seeds are fully ripe, must be collected from the tree before such an event happens, and are better to have fairly large branches left attached, from which the seeds can draw nourishment to allow them to fully ripen up for a few days after being broken off the tree. But such seeds collected in this way, especially if hardly mature, must be sown almost immediately or there is a great danger of vitality being lost. The seeds of the Eucalyptus (gum trees) are contained in hard woody fruits which open at the top by valves when thoroughly dried, but they may remain on the trees several years before they dry enough to allow them to shed the seeds; if the branch is broken off, however, all these valves open within a day or two and the seed escapes, mixed, as it is in this case, with a good deal of seed-like chaff. Consequently, the method of securing Gum seeds is to break off the seed-fruit or branches bearing these, and to expose them to the weather, spread on a sheet from which the clean seed can be collected after it has been shed. But it is necessary to do this in a sheltered place, for the seed is so fine that a very light wind blows it away unless protected. Shaking the dry branches, or turning the seed-vessels, helps the escape of seed, especially at the warmest hour of the day.

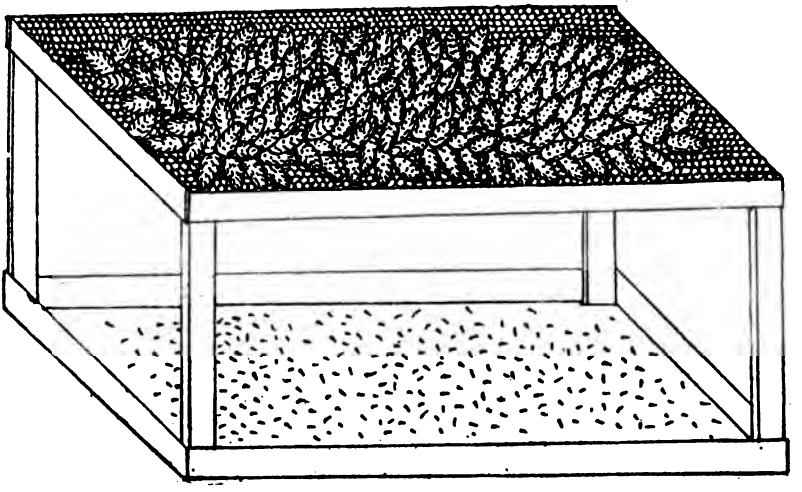
Casuarinas require almost the same treatment, but with this difference, that the picking must be done just when the seed aproaches ripeness, as, if left too long, it is apt to shed naturally, and is so fine that it cannot afterwards be collected.

Pine seeds are borne in woody cones, the scales of which are so rigid that they retain the seeds for many months after they are mature, but if the cones are collected when apparenty ripe and spread out in bright sunshine, they open out and shed their seeds within a few days, especially if raked over while the sun is very bright (Fig. 1). As the expansion of the cone does not all take place at once, it is advisable, where much is being collected, to erect a wire netting framework on which the cones can rest while the seeds drop into a tin or canvas collector below, and are removed daily. This drying frame may be of any size to suit work in hand; for pines 4 feet wire netting of 1 inch, 1½ inch or 2 inch gauge answers well, the mesh varying with the species (Fig. 2). In Europe heated kilns are in common use for expanding pine cones and liberating the seeds.

Blackwattle seed is most easily collected by taking advantage of trees felled for barking, and collecting ripe seed-pods



1.—Cones of Cluster Pines (Pinus pinaster).
a. Cone containing seeds. *b.* Cone after seed is shed.



2.—Drying frame for extracting seed from pine cones.

from them, which, if quite mature, burst on exposure to sunshine and release the seeds, but if hardly ripe, sometimes dry without opening, and then require severe threshing in the bags to open them.

Other Acacias require similar treatment, though sometimes in the case of *A. saligna* as well as *A. Mollissima* the clean seed may be simply swept up from the hard ground-surface under the trees.

In not a few instances care has to be exercised in collecting seeds to prevent the fine hairs surrounding them from irritating the hands, *Lagunaria Patersoni*, *Sterculia diversfolia*, *Hibiscus tiliaceus*, and others being offenders in this respect. All seeds should be collected dry if possible, and the further drying done in a shed facing the sun, or at least in a position protected from rain and driving winds.

Seeds inherit to a certain degree any traits of character belonging to the parent tree, consequently trees acclimatised to upland or to thorn-veldt conditions should be preferred as seed-bearers for seed to be used under similar conditions. On the contrary, coast grown seed which may inherit tender qualities should not be used up-country. But almost all imported seed comes from harder conditions than ours, and is consequently safe for use here if the Natal climate naturally suits the tree.

Preserving Seeds.—After being sufficiently dried, if not to be sown at once, seeds should be preserved in accordance with the requirement of the kind. In most kinds success is best attained by sowing at once, but it sometimes happens that by doing so the seed is made to germinate just as winter is coming on, and the seedling may be damaged by frost or cold. With Acorns, Chestnuts, Walnuts, and several other large and rather perishable seeds, sowing at once is the best method if the winter of the locality is not too severe for the seedling plant, but where that is the case preservation has to be resorted to. As already mentioned, Oak acorns, if collected and dried, retain vitality for a few months, but they do so better if pitted like potatoes in a cool place but with more earth intermixed, while some growers consider that they keep better if immersed in running water and left there till wanted. Dry sand and dry charcoal are both considered good preservatives, and the latter is often used in sending perishable seeds from Europe to South Africa, but in a recent experiment in sending seeds of a rubber tree, *Hevea brasiliensis*, from Ceylon to Madagascar, in which these perishable seeds were a month on the voyage, it was found that powdered charcoal was the least satisfactory of the four methods employed, the others being (1) the seeds sown in soil in Wardian cases, (2) stratified in cocoa-nut fibre roughly powdered. The results with these were in the order stated, (1) giving full germination on the voyage and arrival in good condition, (2) 80 per cent. germinated after arrival, (3) 65 per cent. germinated after arrival,

while the charcoal gave 53 per cent. Dry lime is also occasionally used, especially for such resinous seeds as are apt to decompose and get into a wet mass.

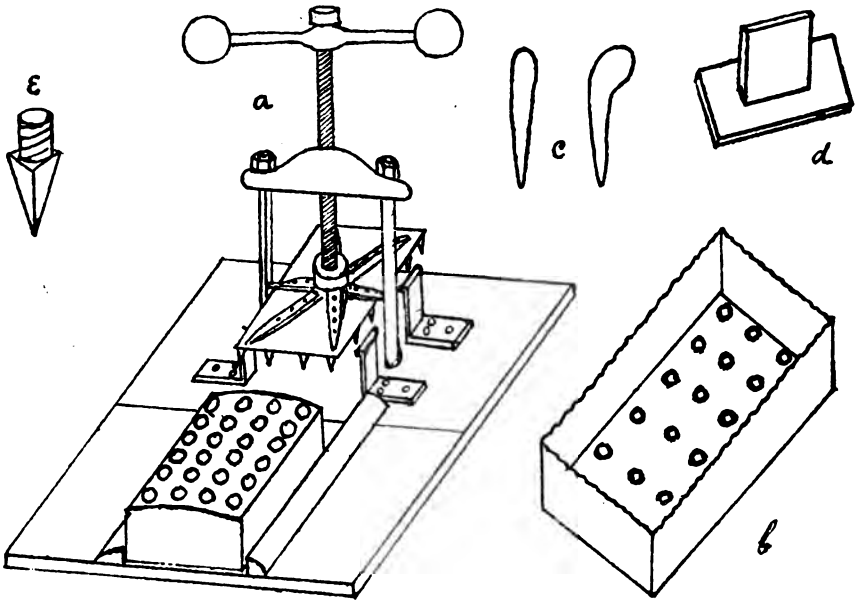
Several seeds, like the Hawthorn and the Ash, do not naturally germinate within a year from the date of sowing, and as they are likely to be disturbed by weeding if sown in an open bed they are more usually stratified in a box, by placing alternate layers of soil and seed to any depth, and then burying the box for a year, after which the seed is cleaned out and sown in the usual way, and germinates in a short time. These seeds keep, however, as dry seeds fairly well, but often takes a year or more to germinate after they are sown after being kept dry.

Among kinds which require some preservative treatment during shipment or storage are Araucarias, Acorns, Chestnuts, Walnuts, Hickories, Camphor, Juniperus Bermudiana, I. Virginiana, Cedras deodara, and the large resinous seeds of the less common pines, as well as many other trees which are not in common use here on account of this difficulty; also most seeds out of pulpy fruits, such as Apple, Pear, Quince, Hawthorn, etc.

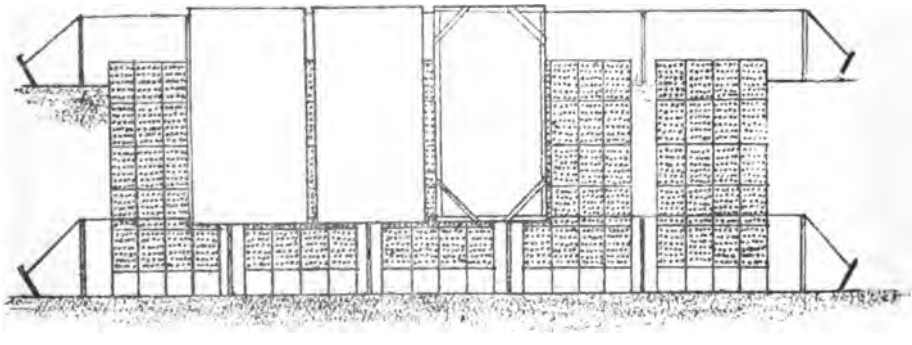
Kinds which require no preservative treatment keep well in preserve bottles, or even packed in paper and stored in a dry place, but seeds in paper or cloth bags are always subject to the attacks of mice and rats, as well as of insects, unless stored in tin-lined bins, and any seeds stored in large bulk should be stored in such bins and occasionally treated with bisulphate of carbon as an insecticide.

Sowing Seeds.—Only a few kinds of tree seeds stand being sown like agricultural crops and left to look after themselves. These will be referred to later, but for the majority of seeds nursery treatment and constant care is necessary. Under the nursery treatment the seeds may be either sown in the open beds, or in specially prepared tins or boxes. The latter is the more convenient method where tins are obtainable, as the tap-roots of the seedlings are checked by the tin, and made to develop more numerous side-roots, whereas in the open bed they are apt to go downward too rapidly without developing any lateral rootlets, and the trees then suffer when transplantd (Fig. 5 a and b).

Five-gallon paraffin tins cut lengthways make two very suitable plant trays, each 13 x 9 x 4½ inches. These tins are good alike for seed tins and for pricking seedlings into more sparsely afterwards, and in most South African nurseries are the only plant-tins used. For seedlings as well as for transplants they require abundant drainage, which is secured by driving holes through its bottom with a pick-end, and then strewing in an inch depth of rough dry branches, dead grass roots, turfy clods, small stones, or other similar material,



3.—*a*. Tin-punching machine.
b. Tin punched, ready for plants.
c. Wooden dibbers.
e. Tooth of same.
d. Plank for levelling soil.



4. Beds of transplant tins covered by light hessian screens.
Shades resting on elevated tight wires.
One shade inverted to show its construction.

covered lightly with dry leaves on which the soil rests. The tin should be inverted while the holes are being driven, otherwise the rough edges protrude downward and come in the way when rootlets find their way through the drainage-holes and have to be scraped off. Where a large number of tins are being handled a machine may be used for driving the holes. Fig 3a illustrates such a machine invented by Mr. A. N. Pearson, and now in use at the Government Nursery, Central Experiment Farm. A machine for cutting the tins is also badly wanted.

The tins, after being supplied with drainage material, should be placed on the prepared level beds where they are to remain, and filled almost full of soil, the upper part at least of which should be sifted through a half-inch sieve. Gentle pressure may be given so as to secure a firm, equal, and level bed, the simplest instrument for the purpose being a small plank with an erect handle on the upper side, screwed through (Fig. 3d). Upon this level surface the seeds may be sown and the plank again used to press the seeds into the soil, after which finely sifted soil or sand should be sprinkled equally over them, and the tin watered through a fine rose so as to settle the soil closely around the seeds. The depth to which the seeds should be buried varies with the kind, but a safe rule is to cover them only to the same depth as the thickness of the seed itself. Thus for all fine seeds as light a covering as can be applied is sufficient, while for oaks or walnuts nearly an inch of covering is necessary. This covering to the correct depth is one of the secrets of success in nursery work, and it is hardly possible to get natives to use little enough soil in covering seeds. So also in broadcast field sowing it is not possible to regulate the depth of sowing sufficiently, hence in the field much more seed is required for a certain number of plants than is the case in the nursery, where, in capable hands, every fresh seed should produce a plant. Some seeds are so fine that they cannot be covered at all without danger of the covering being too deep; such seeds are sown on the surface and watered lightly to fix them, the tin being placed in a close box to prevent the seed from being blown away, and a sheet of wet blotting-paper or cloth laid over the surface and kept damp till germination has taken place, when it is removed, and a light covering of loose straw supplied instead.

All fine seeds are better to be shaded in some way for a time; indeed, most do best when shaded till after germination has taken place. The reason is that, since the seeds are so near the surface, the surface soil must be kept moist, and this is better done and more easily done by shading than by constant watering. The usual method is to cover lightly with loose straw lying on the surface soil; this straw, however, requires to be reduced in quantity as soon as germination has been secured, and removed altogether soon afterwards, or

else the seedlings rapidly get "drawn," that is, they become too long and too weak, and are then very liable to injury from many causes. But if young seedlings which have been protected while germinating are fully exposed while still tender there is a danger that they may become scorched by sunshine, and also that the surface soil may dry out too much. To prevent this several methods are adopted. Where only a few plants are being reared on a farm shelter and shade may be secured by standing upright among the seedlings a few leafy branches one or two feet in height. But where active nursery work is being carried on a better and more easily regulated method is to have a series of covers or shades in use, each made by nailing hessian to a light wooden frame of 2in. x 1in. jarrah, 6 feet long, 4 feet wide, and with corner ties, these shades resting about a foot above the seed-tins on No. 8 galvanised wire tightened along the tops of two rows of short posts, as shown in Fig. 4. For any seeds which are not extremely fine these hessian shades are sufficient without the straw covering, and they have the advantage that they can be removed and stacked at night, or during dull weather, while during bright sunshine or heavy rain or hail they can be put in position, and effectively prevent damage. Shades of light brushwood are also in use, but are too heavy and too dense, besides being expensive in making.

Seeds should be watered only by means of a fine rose until some time after germination, and watered as little as possible if the surface can be kept moist by shading and shelter. Houses having either glass or canvas roofing are in use for rasiing seedlings, and are convenient to work in, but the seedlings rapidly become "drawn" unless the tins are near the roof. Fig. 8 shows section of a useful canvas-covered house, in which by having the passage sunk below ground-level the plant benches are kept high, while ventilation is secured at the top. The number of seeds to be sown per tin varies very much, but in most cases an average of 300 seedlings per tin is to be aimed at, and sowing regulated accordingly. In a few kinds with large seeds and large seedlings, such as Acorns, Nuts, and Araucarias, this number is too large, and 20 to 30 plants is nearer right. Experience must regulate practise in such cases.

Special Methods of Preparing Seed for Sowing.—Most seeds, if fresh, germinate naturally without any special preparation, but if old they often hesitate to start, though still alive. In such cases soaking for a few hours in cold or tepid water has a beneficial effect; indeed, there are very few seeds which do not germinate more quickly after such treatment, whether old or new. But there are a good many hard seeds, especially those of the various Acacias, which do not readily germinate in the ordinary course, and which in nature usually germinate only after being passed through birds or scorched

in a grass fire. Strange as it may appear, these processes have the effect of hastening germination, but as neither is convenient under cultivation the further expedient has been resorted to of soaking them in boiling water and leaving them in it till it cools, and for some time afterwards, say, from one to three days.

The time required depends on the hardness and age of the seeds; quite new seeds requiring only up to 12 hours soaking, while older seeds require one or two day's soaking, and sometimes even the repeated application of boiling water two or three times. Leguminous seeds most frequently require this treatment, but Pines, Cypresses, and other Coniferoe cannot stand it, and prefer no soaking, or else soaking with cold or tepid water.

Among those which benefit by soaking in boiling water are Blackwood (*Acacia melanoxylon*), Black Wattle (*A. mollissima*), Silver Wattle (*Acacia dealbata*), and other species of Acacia, also Robinia, Gleditschia, Ceratonia (*Carob*), Bauhinia, Virgilia, Erythrina, Umzimbit, etc. It must be noted, however, that when once germination has been started in this way it must be maintained, as the germ dies out readily if dried out afterwards, and cannot, of course, start again, however favourable the conditions. Most seeds having wings—such as the Sycamore (*Acer pseudo-platunus*), Maples (*Acer, species*), Liriodendron, Ash (*Fraxinus*), Bignonia, Pines, etc., germinate better if the wings are removed before the seed is sown, while berries having fleshy or tough coats, such as Assegai (*Curtisia*), Olive (*Olea*), Black Ironwood (*Olea laurifolia*), Yellow-wood (*Podocarpus*), etc., should have the coat removed by hand before sowing in order to facilitate germination. In Podocarpus, Almond, Apricot, Plum, and some other hard woody nuts it is also an advantage to crack the nut before sowing it, but care must be taken not to damage the kernel in doing so.

Mention has already been made of kinds which require stratifying in sand for a year or more before sowing, but if these kinds, such as Hawthorn and Ash, are sown without this treatment the ground must not be disturbed for two years, as seedlings may continue to appear during that period. Camphor seldom comes all at once, occasional plants appearing for years, and the same may be said of the various junipers and Acacias, unless the latter be soaked.

Season for Sowing.—Nature sows when the seeds are ripe, and in nature provision is made that the seeds do not germinate until a favourable season for continued growth has begun. But in artificial afforestation other considerations come in. The trees have to be transplanted at a later stage, and the most important point is to sow at such season as will have the young seedlings in fit condition at the proper planting season. With all, except deciduous trees, the proper

planting season in Natal is during the rainy summer months, therefore the trees have to be ready then. Kinds differ in how long they take to get fit, and planters differ in their ideas of fit size, but assuming that the trees are for extensive plantation work, and to be planted as small transplants, then spring sowing is hardly early enough for most kinds. There are some kinds, such as *Eucalyptus citriodora, Euc Globulus,* Black-wattle (*Acacia mollissima*), and *Hakea linearis,* which rapidly get into condition, and as rapidly get past being fit, for such kinds early spring sowing is quite early enough; but for most Gums and many other kinds autumn sowing is preferable, but necessitates protection against frost in frosty places. In such case the pricking out of seedlings into transplant tins takes place early in spring, and the plants are four to six inches high in December when planting is likely to take place. If these kinds are sown earlier, say, about mid-summer, they have to be transplanted before winter, as the growth then is more rapid, and by planting time they are altogether too large for planting out with safety. Pines, however, are more slow than most other kinds, and require to be sown about mid-summer, while a few of the very slow conifers, such as Scotch Pine, Larch, Spruce, etc., require two or more years before they are large enough for planting out, and consequently should be sown whenever the seed is obtained.

With deciduous trees the important point is to sow so that they will germinate in spring, and enjoy a full season's growth before the leaves fall for the first time. But with some kinds the seeds do not easily keep so long, and in such cases, as for instance the Oak, if seeds are to be had early in the season, they should be sown at once, and the first growth made before winter comes on.

But all this depends somewhat on the locality, for near the coast winter is of little account, even with deciduous kinds, while in up-country districts winter is the most important factor with regard to such kinds.

Soil.—The soil best suited for raising seedlings, and also for growing transplants, is a light sandy loam, not cohesive enough to bake if dry, and yet not light enough to dry out badly. In most places such a soil is easily obtainable, but occasionally an admixture of several soils is necessary to obtain the requisite quality. Clay should be avoided, and chocolate soil is rendered all the better by an admixture of sand. Very sandy soil is improved by chocolate soil, or even a little clay, or by a good mixture of decomposed turf or other humus, though care should be taken not to use for the seed-tins decomposed weeds in which seeds of weeds may still be abundant and fresh. Turf piled for a year, and turned occasionally, forms the best nursery soil, and is always available if a good pile is once formed. The soil should be moist, but not wet, when used; if dry the seed may be floated off, or

plants may suffer before the soil takes moisture, as dry soil repels water even though given freely, while if wet it is difficult to get into the right condition for a seed bed, and is apt to clog and adhere to the dibber during transplanting operations. Soil is obtained in the best condition by taking from the centre of a prepared pile just when it is wanted for use. Manure should not be used, or used only very sparingly, in the seed-tins, except there be reason for rushing the plants on a little in case they are late; even then the better method is to use liquid manure, *i.e.*, water in which manure has been mixed, and to use it weak and frequently rather than strong and seldom.

Most pines suffer if manure is employed, either in solid or liquid form, but *P. insignis* luxuriates in a little.

The objection to using manure with Eucalypts and such other rapid growing evergreen trees is that it makes them so luxuriant that they transplant with difficulty, and it also makes them much more rapidly go past the condition in which they can be pricked out or transplanted; in short, it reduces the season during which they can be safely handled, and where labour is scarce that is a disadvantage.

With deciduous trees the use of manure is less objectionable since they get the whole of the first season in growth, and the stronger such a tree is the better it is, provided it ripens its wood sufficiently in autumn and does not have its roots too widely spread. The use of manure evenly mixed through the soil therefore helps such a tree to find sufficient food close at hand.

It must be kept in mind, however, that trees grown in rich soil and afterwards planted on to a poor soil are apt to suffer; and it is a much better practice to use comparatively poor soil in the nursery and plant into better when the trees are permanently planted out.

Seedlings.—The stage at which seedlings are ready for further treatment varies with the kind. Generally speaking, with regard to evergreen kinds, the earlier it is done the more safe is the operation, provided always that the seedling has some lateral roots. The more lateral roots and the less tap root a seedling has, the more safely it is transplanted. The first change is usually into transplant tins, *i.e.*, the seedlings are transplanted into tins of the same size and prepared with drainage and soil in the same way as the seedling tins, but only about 25 or 30 trees go to each tin, and each of these is dibbed in separately so as to have its new roots separate from its neighbours. This operation appears very simple, but requires skill and care, though with practice coolies and natives become proficient at it.

A round or pistol-headed wooden dibber (Fig. 3c) is the only implement used. The soil having been roughly levelled on the tin and pressed somewhat with the fingers to firm it, especially round the hedges, the planter drives his dibber

nearly the depth of the tin, gives it a turn to prevent soil adhering to it, withdraws the dibber, and has a hole ready for the plantlet. Having slackened up the plants in one end of the seed-tin by means of his dibber, he pulls out one seedling without disturbing the others, or exposing their roots to the atmosphere. If the one he has drawn is just right, its roots are inserted into the prepared hole, so that the plant stands at the same height above the soil as before, and the dibber is again used to press in the soil from the sides, taking care that the pressure is applied to as great a depth as that of the hole, otherwise the plantlet is sometimes hanged by the neck without its roots being in contact with soil. No hard pressure is required, but just sufficient to bring the soil in contact with the roots and make the plant firm. And then the next is proceeded with, and so on till the tin is full (Fig. 6a), when a general levelling of surface soil is again necessary, and the tin should be removed to its permanent site and watered with a fine rose sufficiently to soak in as deep as the roots are.

It may happen, however, that the plants have roots too large for the hole, in which case they should never be doubled up, as such doubled roots generally produce decay and death (Fig. 5c). Better cut away with a sharp knife whatever excess of roots there are, and trim the root-fibres to fit the hole, especially the tap-root, as shown in Fig. 5d, e, f, g, h. Trimming the roots neatly in this way seldom does much injury, and each cut rootlet usually produces several young ones above the cut, so the result is in two or three weeks a mass of fine active short young rootlets, instead of one or two long awkward roots destitute of feeding fibres. Gums, Blackwoods, and Wattles are so vigorous that they often recover, even though the roots are doubled, but pines and other conifers are almost certain to die if the roots are doubled up.

The condition in which the plant is at the time of transplanting affects its chances very considerably. Thus vigorous and active growth is apt to suffer much more by transplanting than trees in which a more or less dormant condition exists. Kinds like *Euc. citriodora*, which are always too growthy, suffer more from transplanting than kinds like *Euc. rostrata* or *Euc. diversicolor*, which usually hang in the seedling stage for some time. All very vigorous kinds are better to be kept rather too dry for a week or so before being transplanted in order to induce a dormant, or at least less active condition, but they should be again thoroughly watered before the transplanting is commenced. This dormant condition is an essential feaure in transplanting, whether in pricking seedlings into tins, or in again handling the transplants when finally planting them out. Pines and most conifers have seasons of growth alternating with dormant seasons, and these latter should always be selected for transplanting such trees.

In the case of Gums, Wattles, Blackwoods, Pines, and most other common kinds transplanting from the seed-tins

should be done when the plants are less than two inches high; at all later stages there is more risk, though the hardy Eucalypts can often be handled after they are 4 to 6 inches high by cutting them back severely, removing an equal proportion of root, and then keeping shaded for a few days after they are placed in transplant tins; and again when being planted out from the transplant tins they may again be severely cut back, and the roots pruned in to a corresponding extent. (Fig. 5h.) Similar treatment can be given to a good many other broad-leaved evergreens, but Pines do not stand cutting back in the same way, and do not require it if reasonably treated.

All seedlings should be shaded for a few days after being transplanted, especially if the weather is bright; but the shades should be removed as soon as the plants show, by a fresh start, that they have recovered and started making fresh roots, as reasonable sunshine then helps them to develop both foliage and rootlets better than shade does. Hessian shades, as already described for seedlings, answer well for this protection, and if placed on a wire framework, as described, they are easily removed when the necessity for shade is ended. It is, therefore, convenient to have the whole nursery, in so far as intended to be occupied by either seedling or transplant tins, fitted with wire supports for the use of these shades whenever they may be wanted. It is also convenient to have the beds of tins six feet long to suit the lengths of the shades, and 3 or 4 feet wide; as many beds as are required being side by side, and separated only by narrow paths of 12 to 18 inches for convenience in watering. (Fig. 4.)

Watering must be done frequently and rather lightly at first; after the plants have taken root it should be more thorough but less frequent—say, once a day in bright weather, three times a week in dull weather, but it is better to give too much water than too little at all times, if the drainage is right.

Before seedlings are transplanted it is not uncommon for a minute fungus to destroy them in patches over a tin, or to clear off all in one or many tins. This is known as "damping off." and sometimes does much mischief where thoroughly established, and where, consequently, its spores are ever present. The easiest way of getting rid of this trouble is to commence a new nursery in another place, and to move no materials from the old to the new, but simply work the old one done as opportunity offers, and sow all fresh stock in the new.

Seedlings are sometimes planted out into their final site from the seedling tins, but this is unusual, and only fits some exceptional circumstances.

Transplants.—After a period varying from two months to two years, in accordance with kind, from when the seedlings have been pricked into the transplant tins, these transplants

will be ready to plant out into their final sites. But it frequently happens that weather or land or labour is not suitable or available when the plants are ready, and they have then to be held over for a time, often for a much longer time than is good for the plants. The plants are best if permanently planted out while they have nice compact masses of short roots not yet intermixed with those of their neighbours; in such cases the mass of roots and its accompanying soil can be lifted bodily out of the tin in a trowel, and deposited in the hole where it is to remain, almost without disturbing either the rootlets of the plant moved or those of the neighbouring plants. No disturbance of actual life takes place, and the plantlet hardly feels that it has changed places.

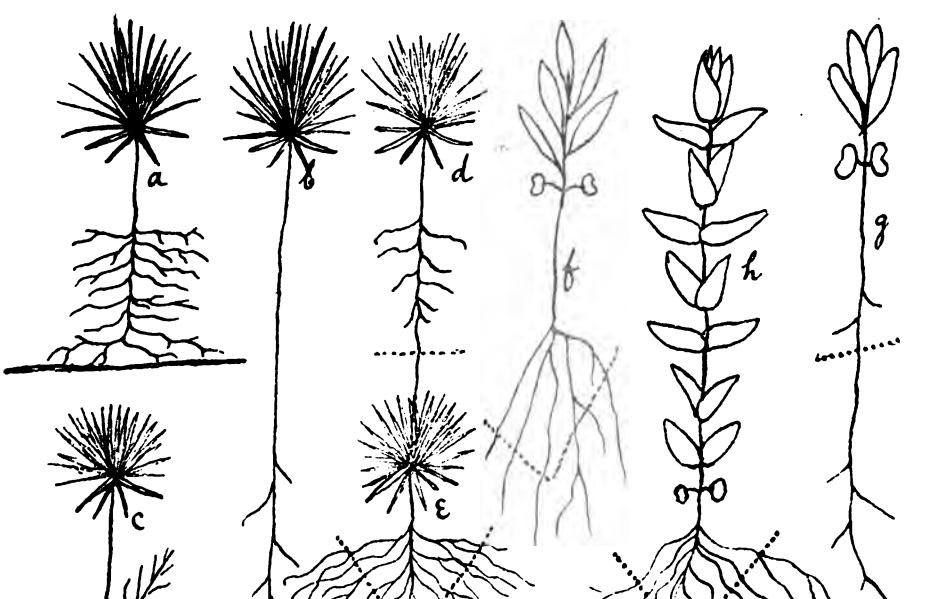
But if there are months of delay the neighbouring roots intertwine, and cannot then be moved with the trowel without breaking those of the plant lifted and disturbing its neighbours. In such case it is best to cut the soil in the tin into squares, one for each plant, by passing a large knife through it between each line of plants and in both directions, and reaching to the bottom of the tin. (Fig. 6c.) This prunes the roots of each tree without further disturbing it, and the tin should then be watered and left for another fortnight where it was, so as to allow fresh roots to be starting again when the tree is planted out, the square ball of soil then coming out easily, and without injury.

It also happens often that when once the tin is fairly filled with roots some find their way through the drainage holes into the soil below, and rapidly assume the lead, and supply the tree with most of its nutriment. Naturally, when this tin is lifted for removal, this leading root is either broken off or hauled out bodily. In either case it is useless to the plant, which suffers more rapidly through its loss than if it had never had it. In order to avoid this, as soon as the roots begin to grow through, the tin must be tilted, and the wandering roots or rootlets scraped away about every second week. Many trees—especially Gums—if they once get a good hold of the soil by means of a root straying through a drainage hole, can never be replanted again, and can then only be cut down unless they happen to be in the right places.

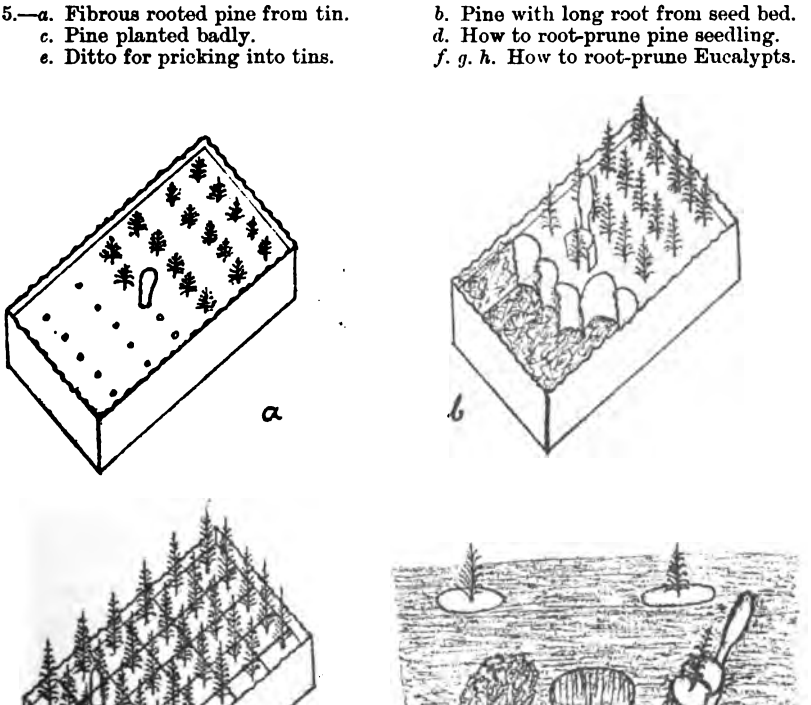
Before planting out, the trees should be kept as dry as they are capable of enduring, for two or three weeks, on purpose to produce the suitable dormant condition already referred to, but the soil should be moist when they are being planted out, and the rootlets should never be exposed long enough to suffer from drought during the planting out process.

Trees prepared as above described are now ready for sending from the nursery to where they are to be permanently planted out; they are also ready for planting out (Fig. 6d), which process will be described in a future article.

Trees in separate Tins.—There is, however, a prevalent though mistaken belief that such trees are too small for rough



5.—*a*. Fibrous rooted pine from tin.
c. Pine planted badly.
e. Ditto for pricking into tins.
b. Pine with long root from seed bed.
d. How to root-prune pine seedling.
f. *g*. *h*. How to root-prune Eucalypts.



6.—*a*. Seedlings being set into transplant tins.
c. Soil cut by knife into squares for easy removal.
b. Transplants being planted out.
d. The planting process.

farm treatment, and that larger trees save time. Of course, if it is not protected after being planted out, no tree is large enough to protect itself against cattle, vermin, fire, and all other ills to which trees are liable, but if reasonable protection is given, in the form of fencing and weeding, the small tree is more likely to spread its roots equally and produce good growth than the large, and eventually it overtakes the latter, though at first it may appear far behind. There is, however, a demand for these larger trees, and it suits the nursery trade to supply them at a much increased price, which the buyer sometimes reads to mean that the plant has actually a higher value. It has cost the nurseryman more for tin and labour, and he consequently requires more for it; with reasonable care there is no risk whatever of losing a plant from a separate tin, but for all practical purposes, except perhaps street tree-planting, or planting for immediate effect round a homestead, the smaller plant is the better if prepared and planted with reasonable care.

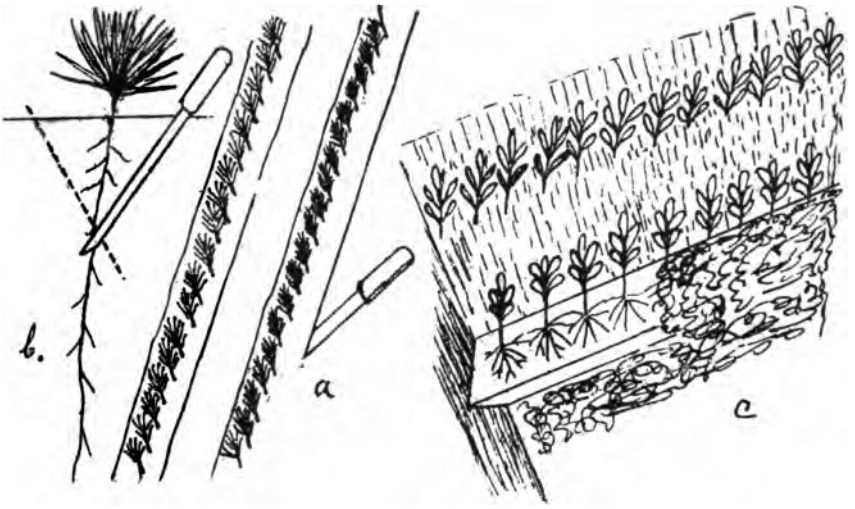
Tins for this purpose are of many designs and sizes, including discarded milk tins, preserved fruit tins, preserved meat and fish tins, oatmeal tins, tea tins, coffee tins, one-gallon paraffin tins cut in half, and five-gallon paraffin tins cut in two crosswise, besides many special patterns cut from sheet material. Only those from which the trees can be taken with whole root-balls are satisfactory, and it is often necessary to cut down one or more sides to allow of this. Such tins must have drainage provided, just as in the case of the flat seed-tins; they are then filled with soil, and the plant inserted in the middle, and gently fixed in position before being watered. Quite small trees pricked from the seed-tins are the best for planting into these, though it is no uncommon practice to single into them trees which have overgrown their transplant tins. The difference of result is that the small tree, given plenty of room, branches out and becomes a nice shapely leafy tree, whereas the overgrown one has usually become lanky and leafless below before it is planted into this tin, and never recovers beauty or foliage afterwards, except at the top.

The high price of separate tins is always a consideration; in India and Australia bamboo stems cut into short lengths make passable and cheap pots, and these are also coming into use in Natal. Grown in half paraffin tins trees may be kept in health till they are four or five feet high, and in full sized paraffin tins with the top removed they may be grown to double that height; but if root-bound, such trees do not readily take possession of the neighbouring soil, and are apt to get blown over, even years afterwards, if only a few straggling roots wander out instead of a mass of smaller ones. Hence the number of street trees which get blown over.

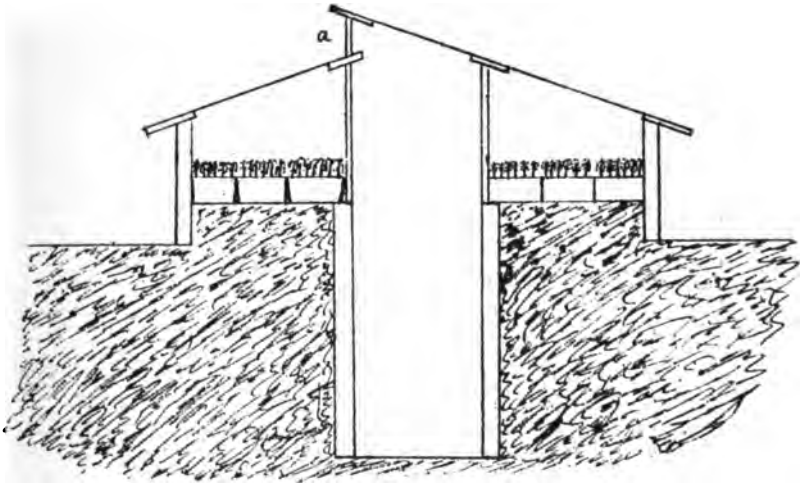
Seeds in Open Beds.—The main advantage of the process already described, under which the plants are in tins so long

as they are in the nursery, lies in their being so convenient for use and so much under control alike in the encouragement and in the sometimes necessary discouragement of growth. But, where care can be bestowed, sometimes equal results can be obtained with evergreens from seeds sown in open beds. For this treatment the bed should be freshly dug, raked very fine and level, given a fine surface of prepared soil if a fine surface is not natural to it, and then sown and lightly covered, as in the case of sowing in tins. A coating of light straw or of dry grass may be sprinkled over the surface on purpose to retain moisture in the surface soil, but this must be examined occasionally to see that mice or white ants are not acting underneath, since these can better escape observation in beds than in tins. The grass should be entirely removed as soon as germination has taken place, but a few fresh straws should be again sprinkled on, or a hessian shade placed over the bed for a time. The real difficulty with seedlings in open beds comes in through there being nothing to prevent the taproots going deep and developing most of their fibres at a greater depth than is convenient for future handling (Fig. 5b). In tins the bottom of the tin acts as a check, and induces root-branching near the surface (Fig. 5a), but in the beds the inducement is rather to develop rootlets at three to six inches depth. If the plants are intended to be pricked into tins as transplants, or even to be pricked out separately in beds, then that process can be performed as soon as the plants begin to develop side roots, and before the tap root has developed too far. But this means immediate action, and a few days delay may render the plants useless. If such transplanting can be confidently anticipated, the seeds may be sown broadcast in the bed, *i.e.*, scattered all over its surface. But if doubts on that point exist, it is better to sow in lines, the lines being six inches apart, and the seeds numerous in the line. Then, if they can be picked out at an early stage so much the better, but if through any cause that is inconvenient, then the plants can be prevented from extending their tap roots and induced to form side roots, by passing a strong knife along each side of the line, the blade slanting under the plants so as to cut off every tap root at a depth of $2\frac{1}{2}$ or 3 inches (Fig. 7 a b). No further action is required at the time, except watering, to settle the soil again; indeed, sometimes it is better to cut only one side of a line at a time, and cut the other side a week afterwards, so as not to inflict too severe a check all at once.

Pricking out singly, either into tins or into beds, should be done as soon as the plantlets are fit to handle, and have developed a few side roots—say, when they are two to four inches high, in accordance with kind, and is more successfully managed with small than with large plants, since the latter have usually a root-growth corresponding in vigour and extent with the leafage above. The process may be performed by means of a wooden dibber, as described for use with tins,



7.— *a*. Shortening the roots of pine seedlings in nursery lines.
b. Section of same showing what takes place.
c. Planting Eucalypts into nursery lines.



8.—Seedling house made of hessian cover, on light wooden framework. Ventilation is provided between the two roofs at *a*.

or by a trowel, or it may be done with the spade, in which case after the new bed has been raked to a fine surface and the line set, the soil along the line should be patted firm with the back of the spade, and a trench three inches deep cut along the line, with a clear upright face. Against this face the plantlets are set one by one after the taproot has been removed and the rootlets spread out; and the soil is then drawn on and pressed firm, and water applied. (Fig. 7c). If these lines are placed six to twelve inches apart, they are then so placed that further cutting of the roots can be conveniently done if necessary, and that weeding with the hoe or dutch-hoe can be done between the lines.

The larger the bunch of fibrous roots at the time of the final planting out so much the better; what is desired is that the plant be dependent on these and have no long wandering roots. To secure this condition, and also to prevent the plant getting in such a growthy condition as to render transplanting dangerous, it is necessary to cut the roots with a knife time after time in the manner already described, and also occasionally instead of cutting them, to place a fork under the plants and gently lift them loose and then allow them to settle down again where they were without seriously disturbing the soil, but insuring that any long roots are broken. This process is known as "teasing," and during active summer growth it is necessary every two or three weeks if plants are to be kept in condition for moving. By this process Gums, Casuarinas, Blackwoods, Pines, Cypresses, and other evergreens can be kept in condition for transplanting till they are nine to twelve inches high, or sometimes even more; and while the process is cheaper than tins, both through having no tins to purchase and through requiring less labour in watering, it is much more dangerous in that the roots so rapidly get beyond control if the operation is delayed for a few days too long. There is also more expense and difficulty connected with the removal of the plants for final planting out. This is accomplished by lifting the plants with the accompanying balls of earth and packing them in boxes or tins so tightly that the soil cannot get jolted off. But if the soil is light and sandy it is apt to get loose, however tightly packed, and in such a case it is common practice to shake the most of the soil off the roots when lifting them, and then puddle the roots in a mixture of clay, cowdung and water, of the consistency of paste. The mixture adheres readily it does not dry out easily, it has a manurial element which rather encourages production of rootlets, and it takes up less bulk in packing than a ball of sandy soil does. Smeared in this way and then packed tightly in tins or boxes plants may be sent long distances with safety, and though they look rather be-draggled at first they soon recover.

In some cases it is convenient to grow trees on to a larger size in the nursery; in that case they are planted out

in lines at such distance as is convenient for handling them—two feet apart suits most cases. Given a year's growth at this distance most Cypresses, Pines, and other conifers may, with care, be lifted into large tins, or transplanted direct into their permanent places; but, as already stated, except for special cases, small transplants are more satisfactory, while Eucalypts, Acacias, Pepper trees (*Schinus*), and most other rapid growers are not amenable at all to this treatment, as after a year's growth without moving they do not transplant with certainty.

Deciduous Trees.—Deciduous trees require rather different treatment from evergreens, since, on account of losing their leaves during winter they must be sown at such season as will fit in with that. Early spring is the most suitable season for sowing, and the plantlet gets a full season's growth before it loses its leaves for the first time. But where the seeds do not keep well it is often advisable to sow as early in summer as seed can be obtained, and thereby secure a few month's growth before the leaves are first shed. But this has to be regulated by the locality; if there is little or no winter, autumn sowing is best; if winter comes on early, and is severe, spring sowing alone should be practised. Deciduous trees are more easily managed in open beds than evergreens are, and since they are transplanted only when leafless there is no necessity for "teasing" in the way that is done with evergreens. Indeed, the opposite practice is better, viz., to give them manure and water and leave them undisturbed, thereby giving every possible encouragement to make strong, rapid, and continuous summer growth. If this is done the plants are likely to be far enough advanced at the end of the first season to be planted out permanently, but if not so, they should, without fail, be transplanted into another site while leafless. This is done to check the undue development of the taproot, and to encourage the formation of fibrous roots, as far as possible, instead of long stringy ones.

When sown they should be thick enough to occupy the bed, whether in lines or broadcast; when transplanted at the end of the first season they should be planted out in nursery rows two feet apart, and with 12 to 24 inches from plant to plant, in accordance with kind. If at the end of another year the trees are not yet of the desired size, they should again be transplanted, even if planted again at the same distances apart as before. Never transplant deciduous trees while in leaf; a few kinds may stand it, but most do not, and it is cruel treatment for any kind.

Difficult kinds to Handle.—A few kinds, owing to individual peculiarities, are more difficult to handle than most others, or else require special treatment. Most of these are kinds which do not do well if the tap-root is removed, and consequently transplant badly unless when very young. The

Carob (*Ceratonia silaqua*) is an instance; it requires a long tap-root undisturbed, and is consequently more successfully established if sown where it is to remain permanently than if passed through ordinary nursery operations. The Evergreen Oak (*Quercus ilex*) is another which does not transplant easily, except from separate tins, and a good method with it is to sow one acorn in each tin and plant it out as early as convenient, or else sow it *in situ*. The Pepper tree (*Schinus molle*) is sometimes very difficult to manage, while at other places or in other hands there is no difficulty about it; where difficult, the simplest plan is to sow two or three seeds in each tin, and afterwards cut away all plants except the best one in each. *Hakea suavolens* is also very difficult at some places, while easy at others; probably soil or climate has to do with this.

Difficulty of another nature is experienced with such kinds as are so slow in growth that they have to sit in the nursery for several years before they are large enough to plant Scotch Pine (*Pinus sylvestris*), Silver Fir (*Abies pectinata, Abies Menziesii*, Larch (*Larix Europea*), and others being of this class, and usually less than three inches high when three years old.

In a few cases the seeds are so fine, or so easily blown away, that they can only be sown during mild weather, and even then occasionally get floated off. Birch (*Betula*), Beefwood (*Casubrina*), and *Cedrella toona* are of this nature, as well as some the Eucalypts. Willow and Poplar seeds are enveloped in fine wool, which prevents the seeds coming in contact with the soil, and so interferes with germination. These may be sowed among the mud along the banks of a pond, or sown in tins of soil, but only covered by a sheet of blotting paper, and that kept very wet till the seeds germinate. This can also be done with Plane-tree seeds, which are difficult to keep under soil or in contact with it.

With a few kinds difficulty is experienced through their extraordinary vigour rendering them always too active for transplanting; in such case cutting back has to accompany the transplanting process.

"In situ" Sowing.—Sowing "*in situ*" is the name given to sowing where the trees are to remain permanently. In some places it is found that the number of transplants which die immediately after being planted out is so large, and the filling up of these blanks so expensive, that it is better to do all the work by seeding instead of plants, while in other places the winter is too dry to allow the deciduous trees to be transplanted while leafless, and it is then necessary if Oaks or other deciduous trees are to be used to sow instead of planting them. The largest work in this way in South Africa is that practised by the Cape Forest Department, which sows annually many tons of Cluster Pine (*Pinus pinaster*). The preparation varies with the district and the soil, and climate. Usually

ploughing, harrowing, and sowing soon afterwards is all the process, the seed being sown broadcast by hand, like wheat or oats, at the rate of 20 to 30 lbs. per acre, and lightly harrowed in. The sowing can be done whenever the soil is moist enough—during spring, summer, and autumn in Natal, and the Eastern Province, and also during winter in the Western Province of Cape Colony. Where mountain ground has been turned up by kafir hoe instead of by plough, and where the place is too steep, or rugged, or rocky for covering by harrow, a bush harrow consisting of a bundle of branches tied together may be used instead, while in places where heavy daily rains fall during summer, or mists hang frequently, the ploughed or hoed ground should be roughly harrowed to freshen the surface, and then sown and left without further work, the rain or mist pulverising the ground, and doing all the covering that is necessary. There is always more danger of too much covering than of too little, though in some places birds have to be herded off for a time. Cluster Pine sown in this way usually does not require weeding further than the removal of a few of the largest annual or biennial weeds, but ploughing should preferably be done at such season as will produce no grass growth, as grass endangers Pines from fire much more than annual weeds do. Most upland districts of Natal suit broadcast sowing of Cluster Pine, but not the hot flats and kopjes of the Tugela basin. No further treatment is required for several years, as the trees should stand close enough together to prevent undue branching, but sooner or later a considerable thinning out is required if the crop is sufficiently thick at first.

Pinus halepensis is also sown in the same way, but as the seeds are smaller, 10 lbs. of seeds gives as many plants as 20 lbs. of Cluster Pine. The other kinds of Pines mostly have seeds too high priced for broadcast sowing, but with them the practice is sometimes adopted of marking off the prepared ground in the same way as for planting, and then making a small seedbed of fine soil, and sowing therein three or four seeds at each place where a plant should be.

This is also done with many other kinds of seeds, including some of the Eucalypts, but not usually with the same success as in the case of pines. The seeds of Eucalypts are so fine that they cannot be covered to a reasonable depth by any farm method, but where a grower has parent trees of his own, and can consequently secure seed at much less cost than the market rate, good germination can occasionally be secured by sowing fresh seed broadcast, 2 lbs. per acre, just before rain is expected to fall.

The treatment of Black Wattle from seed has been dealt with in the January number of "The Agricultural Journal," and almost all other Acacias require similar preparation of seed, and similar culture in so far as deserving of field cultivation.

Acorns, Black Walnuts, Chestnuts, Wild Chestnuts, and other deciduous or semi-deciduous trees are often sown *in situ*, but seldom broadcast, since they are more easily weeded, of that be necessary, during the leafless period, if they are in lines. Lines 5 feet apart and seeds 3 feet apart in the line are sufficient espacement for these kinds if all the seeds grow, which must be provided for either by hand selection of the seeds or by sowing two seeds together where one plant is wanted. The seeds are sown in excavations made by the hoe, or in holes made by the dibber, but should touch the soil below them as well as at their sides, and they should not be covered more than an inch.

Pines are also occasionally sown in lines, with continuous sowing along the line, but this is much more expensive than broadcast sowing, and if mice are present they soon find the lines and follow them, destroying every seed.

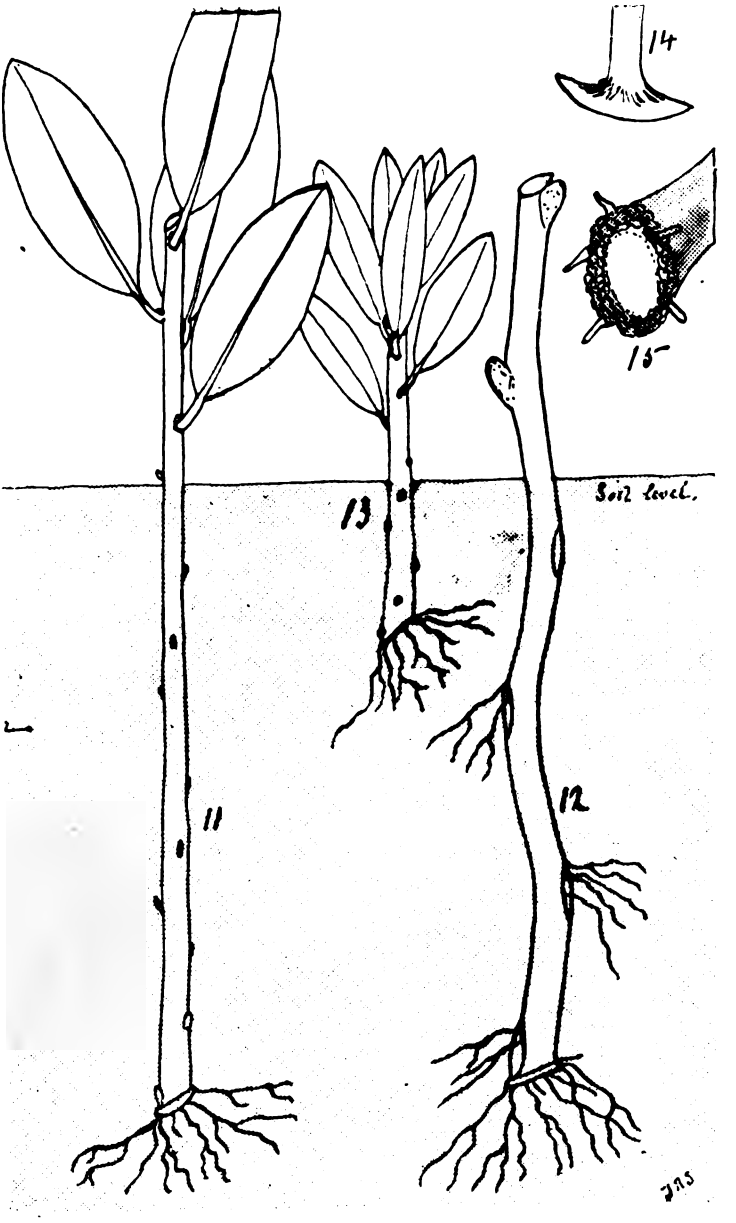
CHAPTER III.

PROPAGATION OF TREES BY MEANS OF CUTTINGS.

Propagation by division is an everyday practice in regard to Begonias, Pelargoniums, Roses, and other flowering plants, and the process is well known to every horticultural enthusiast. But with regard to trees and shrubs the practice is less common in Natal, and the methods less clearly understood, and in no other branch of plant culture is the Natal reader more easily led into error by following foreign advice than in this. For instance, in most English and American horticultural works the propagation of Acacias, many kinds of Pinus, and even Eucalyptus, is recommended "by seeds or cuttings." Many large nurseries in Britain do little else than propagate Cupressus, Arbor-vitae, Pinus, Abies, and other Conifers by means of cuttings, and Acacias are usually so propagated there, while in South Africa, it may safely be asserted, no Pine-tree, no Eucalypt, and very few species of Acacia or Conifer have ever been raised from cuttings.

And so it is in other kinds. Each country has methods of propagation which suits its own circumstnaces, and it adheres to them. Natal is no exception in this; it has adopted the method of raising mostly from seed because that suited its circumstances, not because the trees changed their ability to propagate by cuttings when grown in Natal. The special circumstances of Natal arise through several causes. Perhaps the most important is that, in older countries and countries less blessed with favourable conditions and exuberant vegetation, every sport that any hardy variety may produce, whether in form, habit, leaf-cutting, variegation, colour of flower, doubleness, peculiarity or monstrosity of any kind, is carefully propagated and cultivated as a new and improved variety. But such varieties, originating in a natural sport, always have a tendency to revert to the original if multiplied by seed, hence the practice has become common of increasing all such sports by means of cuttings, grafts, buds, or other artificial means and special arrangements are made for carrying on this practice as an independent skilled industry, though one in which amateurs often become experts.

In Natal, with its abundant indigenous tree flora, and its suitablity to a very large number of exotic species, a sufficient variety of flower foliage, form, colour, etc., is obtained by the use of species, without having recourse, except to a limited extent, to the use of sports requiring propagation other than by seed. Consequently the practice is used to only a small extent, and no special contrivances are in use for insuring success.



11. Hardwood cutting of evergreen.
12. Disbudded hardwood cutting.
13. Soft-wood cutting.
14. Heel often used with hardwood cutting,
15. Base of cutting, shewing callus, and beginning to produce roots.

Then there is the difficulty that without such special contrivances the climatic conditions here are not always favourable. What are known in Europe as soft-wood cuttings—*i.e.*, cuttings of wood only a few days or weeks old—are so easily dried out under the greater heat and drought prevalent here that they absolutely require protection, and seldom get it; hence they are condemned as failures.

But even what are known as hard-wood cuttings are usually used in Europe of a size so small as to completely dry out under the conditions prevalent here during winter, the season when such cuttings usually require to be made. Consequently with these also there are many failures which in Europe are avoided, and the practice altogether is not much in favour.

Still, it has advantages. In some cases—Privet, for instance, where seed is scarce, or Grape-vines, where seedlings revert to the wild form—it is the only means of increase, and in all variegated plants it is the surest.

Hard-wood Cuttings.—These consist of wood which has gone through one or more growing seasons, and is hard and woody in texture. Such wood is often soft or immature towards the points; this soft part should be removed, leaving only what is hard and firm and not likely to dry out, though if quite firm the point also may remain. For convenience, a length of ten or twelve inches is best.

If the point is removed it should be done by a clean cut immediately above a bud; the lower end should also be dressed by a clean cut immediately below a bud, and all branches, twigs, or developed buds should be cut clean away (Fig. 11). What happens after the cutting is set in the ground is that the vegetable cells of the cambium layer (*i.e.*, the cells immediately between the bark and the wood) commence to grow and multiply outward on the cut surface in the ground until there is developed a more or less distinct ring or irregular mass of cellular tissue, known as a callus, from which roots are given off (Fig. 15). If branches or buds above the base have been removed, it frequently happens that callus is formed there also, giving out roots in time (Fig. 12), and in some species there is a tendency to develop roots at every joint, even though no cut be made.

The sap which causes or allows the increase of cambium cells is descending sap from the cutting itself, and as the greater the surface of cambium exposed gives the greater opportunity to callus and form roots, most propagators use an oblique cut at the base of the cutting having the bud opposite its upper end.

Some kinds strike root even though the cut is away from the bud, but in most kinds it is only at or near a bud that roots are readily given off. In most kinds it is an advantage to use as a cutting the lower part of a branch, leaving on it a

"heel," or portion of the older branch from which it sprang (Fig. 14), though this is not absolutely necessary.

Cuttings develop roots much more freely in light sandy soil or even in pure sand, which keeps moist without being saturated, than they do in any stiff heavy soil. They also develop roots most readily when growth is dormant and the sap naturally going downward, that is, during autumn and winter; if set in spring or summer there is always a tendency for the sap to rise and produce point growth or develop buds without forming roots, and naturally such cuttings die off quickly, though they promise well at first. If the trees are deciduous, cuttings should be set when the leaves fall, or shortly before that; if evergreen, all leaves should be cut away except as will be above ground (Fig. 11), and these may also be removed is large, for the less evaporation or transpiration there is from a cutting until it is rooted, the greater is its chance of success.

A hard-wood cutting should be set with three-fourths of its length underground; this exposes only a small portion to insolation, but quite enough to produce a good plant, while if the cutting was twelve inches long it has the roots mostly formed at a depth of about nine inches, a sufficient depth to prevent injury from drought if the tree is to remain where it is struck, and also a convenient depth at which to have the roots if the tree is to be moved (Fig. 11-12). Cuttings eighteen inches long (as they are often made), have either too much stem exposed above ground or the roots produced at an inconvenient depth, or both of these faults.

The age and strength of wood used for cuttings varies with the species, the condition of the wood, the time of the year, and the kind of season, but, generally speaking, the lower end of the cutting should not be less than one-third inch in diameter, while material of one inch diameter is more sure. In a few kinds, such as privet, pomegranate, and weeping willow, quite small cuttings—both as to length and diameter are quite safe if planted late in the autumn when the wood is mature.

Hard wood cuttings should be planted without delay or exposure immediately after being made, and watered sufficiently to settle the soil around them.

They may be planted singly where they are intended to remain permanently, but in that case are inconveniently placed for future watering or attention, and it is usually better to set them in nursery lines, the cuttings six inches apart, and the lines two feet apart; in that arrangement they can grow for a year and be planted out the following autumn or succeeding spring, for such plants in the open ground are rather difficult to transplant during summer, even though evergreen, and this should never be attempted if they are deciduous. The cuttings should be set upright, for if set leaning, as

they usually are, they are very apt to be cut off above the roots when being dug out for transplanting.

In most nurseries, where many cuttings are being made, the method adopted is to have them made in the shed from May to July, several hands being constantly employed making, while others are setting the cuttings made. But to ensure success the cuttings are not set out in nursery lines, they are set almost as close as they can stand in lines two inches apart, in frames six feet wide and of whatever length may be necessary for the stock; the frames having wooden or brick sides 18 inches deep and containing 12 inches depth of pure sand, in which the cuttings callus and remain until spring, when they should be permanently planted out just as the callus is beginning to develop roots To ensure an equal cool, moist atmosphere around the exposed part of the cuttings, the surface of the frame should be covered with hessian shades, night and day at first, and the site for the frame should be one sheltered from wind and from sunshine. After the cuttings have been in the frame for six weeks or more, the shade may be removed on favourable occasions, so as to harden the cuttings before they are fully exposed when planted out.

This method can be used on a smaller scale, but with equal success to the amateur propagator.

Theoretically, all species of trees are capable of being propagated by one or other of the methods already named, and in Europe most species in cultivation are so propagated, but in actual practice in Natal only a comparatively small number of the kinds in use can be multiplied without the use of appliances not yet in use. Most of these few are, however, propagated by hard-wood cuttings in the manner just described. Among trees may be mentioned Plane (*Platanus orientalis* and *P. occidentalis*), Ash (*Fraxinus*, all species), Cottonwood (*Populus monilifera*), Lombardy Poplar (*Populus fastigiata*), Weeping Willow (*Salix Babylonica*), Osier (*Salix viminalis*), White Mulberry (*Morus alba*), Catalpa (*Catalpa bignonioides*), Tamarisk (*Tamarix*)—Elm (Ulmus species), Spanish Chestnut (*Castanea vesca*), as well as many smaller trees and shrubs, while several hedge plants, including Privet, Pomegranate, Quince, Cape May, Hibiscus and Philiadelphus are regularly propagated in this way. On the other hand, Gums (*Eucalypts*), Wattles (*Acacias*), Pines (*Pinus* and *Abies*), Cypressus, Maples, Robinia, Gleditschia, and many other kinds regularly fail if tried by this method.

A curious case of "cussedness" is that of the common Peach, which hardly ever strikes if carefully prepared and set, but seldom fails to do so if carelessly stuck in to support a label. Some kinds, which do not strike regularly, may be assisted to do so by removing the point and then cutting the stem half through at the proper length and leaving it still in its place until it gets callused more or less, and hardened in

texture, when it may be removed and set in the ground. Others require to be cut nearly through, and gently broken over, leaving the cutting hanging for a time to harden and callus; this gives good results with several difficult Roses, Bougainvilleas, and other rampant and somewhat soft-wooded shrubs which require a check to make them dormant enough to root first and grow afterwards.

Truncheons.—To overcome the difficulty often experienced of small cuttings drying out before they strike root, some growers only use heavy truncheons, four to twelve inches in diameter and 12 to 24 inches in length. All the kinds mentioned above as growing from hard wood cuttings grow with greater certainty from such truncheons, but this method is so cumbersome that it can only be used around a homestead, and is of no use for commercial purposes

Some kinds, however, such as certain varieties of apple and pear, will grow from such truncheons, though they seldom strike from small cuttings. Others will grow from such truncheons, even though several feet in length and mostly above ground, and advantage is taken of this to produce fireproof fences by having the poles set of living wood of such kinds, which, when they get into growth, continue green, and are less liable to damage by fire than are dry sneezewood poles. Among kinds which can be used in this way are Weeping Willow (*Salix Babylonica*), Lombardy Poplar (*Populus fastigiata*), and Cottonwood (*Populus monilifera*), besides the following and other indigenous kinds, viz.:—Kafir Plum (*Harpephyllum Caffrum*), Kafir-boom (*Erythrina Caffra* and *E. latissima*), Dog Plum (*Ekebergia capensis*), Cork Wood (*Commiphora*) Heteromorpha, *Hibiscus tiliaceus* (Um-lolwa), and several species of Ficus (Mpai, Ntombe, Uluzi, etc.); the Hibiscus and Ficus being, however, more or less distinctly coast species. Most of these indigenous kinds also grow from smaller hard wood cuttings.

Generally, truncheon cuttings do best if set in spring, but there is one notable exception to this, viz., the Kafir-boom, which, if set in spring, produces soft branches by mid-summer, which are invariably damaged beyond recovery by a boring grub, and the stem is unable to shoot again and subsequently dies: whereas if the pole is planted about mid-summer, the shoots are produced after the grub's season of attack and ripen sufficiently before winter to shoot again and retain life, even though the grubs do in spring attack the first green shoots, as usually happens.

Cuttings from Stools.—In several of the kinds mentioned above as fit for reproduction from hard wood cuttings, it is found that branches from the upper part of the tree do not strike so readily as those from the base, so when a stock of cuttings is wanted it is common practice to cut the main stem back to near the ground level, so as to induce a free production of coppice shoots, which, after a season's growth, make the surest cuttings, especially if removed close from the stock

and each allowed to retain some of the callus surrounding its base. This sureness to strike is further aided if soil can be drawn up over the stool after the shoots have got into good growth. If the coppice shoots are cut off close to the ground regularly during winter a good crop may be produced in this way for many years, and though the lower lengths are the surest to strike, still the upper lengths are also more reliable and straight than the upper growth of an uncut tree. Kinds which are apt to fail unless propogated from lower branches or from stools are Plane, Spanish Chestnut, Garden Fig, &c.

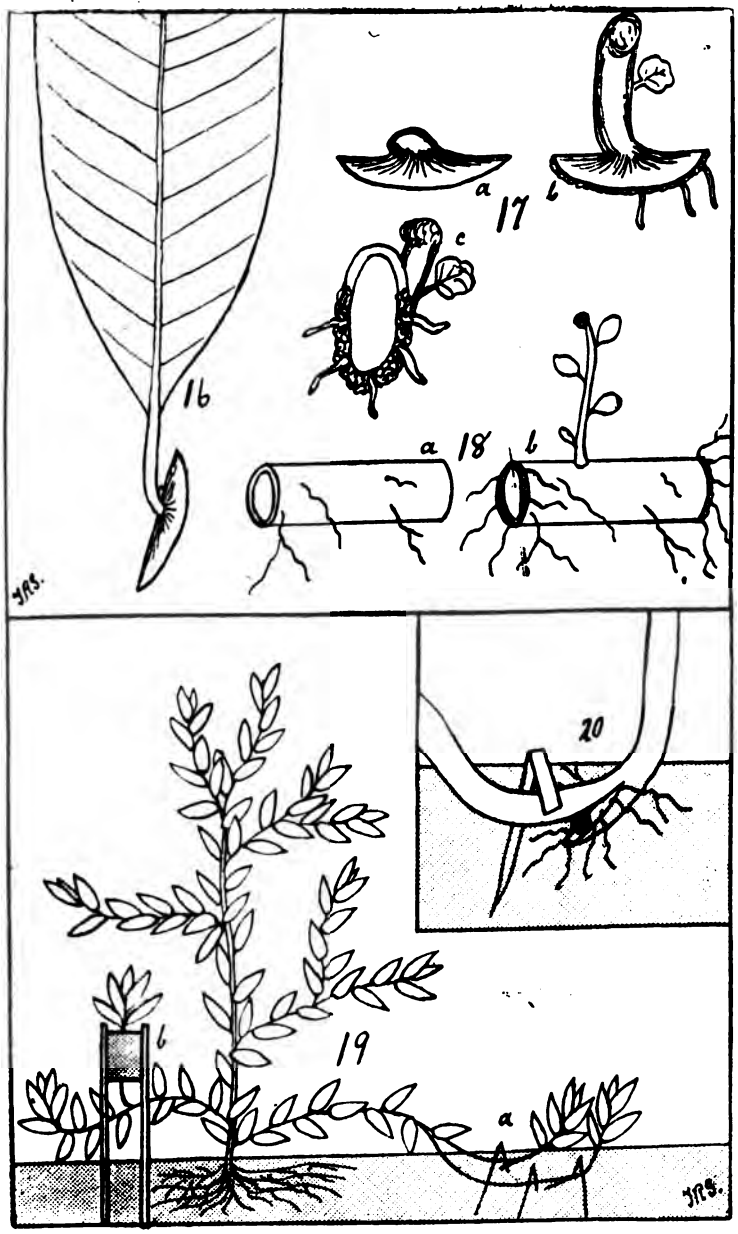
Soft Wood Cuttings.—These are cuttings from the recently formed wood, tender and green throughout, and so crisp that they break across readily with a clean break, and without bending. They are usually only two or three inches long, with the point left intact, and with some or all of the green leaves removed so as to reduce evaporation and transpiration as far as possible. Though they must be in condition to break sharply, they should be cut clean across with a sharp knife (Fig. 13). Soft-wood cuttings of trees do not succeed here except where an even moist atmosphere can be maintained free from sunshine until roots are produced. Under favourable artificial surroundings they are, however, safe and quick, as they root within about two weeks in a proper house, and can be planted out after being hardened off, whatever season they are ready. The necessary appliances will be referred to further on.

Disbudded Cuttings.—Although it is usual for the buds which are above ground to start first into growth, and in most cases to be the only ones to start, still there are occasional cases in which lower buds also start, and as these produce a bushy habit from the base which is often objectionable, precaution has to be taken against this by removing all underground buds before the cutting is set. This is, of course, most easily done in the case of long hard-wood cuttings, and is usually effected by cutting off each bud with a clean knife, the knife entering from below the bud and cutting upwards (Fig. 12). This is much better than simply rubbing off the buds, which process not only produces a rough broken surface liable to decay, but also may, at times, leave dormant buds at the base of the main bud, and these, under pressure, replace the main bud and start into growth. Perhaps the best known cases in which disbudding is necessary, are such fruits as the grape-vine and the English gooseberry, and also all stocks for grafting or budding upon, in which there is always the danger of buds below the graft or bud springing into growth and replacing the worked cion unless constant vigilance is practised. This is very frequently seen in roses, where a strong vigorous shoot from the base is given every encouragement, but on flowering, proves itself the stock, while the budded shoot has by that time died a natural death from starvation or been pruned off, and the nurseryman who supplied the

plant gets blamed for having sent out a weed under a grand name. In the case of the English gooseberry no crop is obtainable from a mass of suckers; it is only where one clean stem is maintained that a crop occurs, and suckers can never be completely removed after they have once started, so the only preventative is to remove all buds from the cutting before it is set. There is also an advantage in disbudding cuttings of any tree which is apt to become bark-bound during times of drought, such as the Plane and the Spanish chestnut, as in the event of that happening, dormant buds at the base readily start growth and rob the main stem, whereas, if they are absent the natural growth of the leader gradually restores the stem to a natural condition.

Cuttings from Single Buds.—Usually a cutting has three or more buds upon it—often many—but there is no necessity for more than one bud if surounding conditions are sufficiently favourable. That, however, is hardly ever the case, except under highly artificial arangement for maintaining a close moist atmosphere with suitable temperature of soil and air, such as can only be obtained in a special propagating house. There are cases, however, such as some species of Ficus, in which a full-length cutting seldom does well, but in which single-bud cuttings are usually successful (Fig. 16). What happens is the exposure of a cambuim surface large in proportion to the whole cutting, and, consequently, on the formation of callus, an ability to support more, especially if the stem is green and liable to either transpire or evaporate moisture. This method cannot be used for general work by the public, nor is it often successful except with the best appliances and in skilled hands; still, under these conditions, it is often used in Europe to rapidly multiply a scarce plant, and it is quite applicable here, should occasion arise. For instance, every precaution has to be taken against the introduction and spread of Phylloxera in grape vines; this practically prevents the importation into the Colony of the better varieties of vine in quantity, but no plant is more easily propagated by single buds than the grape vine (Fig. 17). Consequently, if small stocks are imported under stringent supervision and quarantine, the propagation and distribution afterwards is about five times as great the first year from single buds as from hard-wood cuttings, with a correspondingly larger stock to work from for subsequent years at the same increased rate.

Layers.—The practice of propagating trees by layers is adopted only in the case of some kinds which do not strike readily from cuttings, and where greater success is insured by this means. In it, cuttings are not removed from the parent tree when first taken in hand, the branch is only partly cut through and then left to callus and root while the life of the cutting is maintained through the part left uncut. To assist rooting, branches near the ground are usually selected for



16. Cutting of Ficus with single bud.
17. (*a*) Cutting of Grape-vine with single bud.
(*b*) Same started into growth (*c*) Under side showing callus.
18. (*a*) Root-cutting as set. (*b*) Same, started into growth.
19. Two methods of layering. (*a*) In the ground. (*b*) In a raised tin·
20. Usual method of layering.

the purpose, and bent down until the cut part can be inserted into the soil and pegged into postion there, leaving the point of the cutting above ground through being bent upward (Fig. 19a). The cut is always made on the under surface of the branch, sometimes a slice being cut off entirely, but more often an oblique cut inward and upward is made about half through the stem, and a small stone inserted to keep the split open (Fig. 20); this then exposes the cambium of the protuding tongue, as well as of the acting stem to produce callus, and the former at least receives only descending and elaborated sap fit for cell formation, while the other part supplies nourishment to the layer.

Soft-wooded shrubs, like bongainvillea and climbing roses, strike root most readily in this way, but the method is also adopted for some hard-wooded trees and shrubs which in the ordinary course take so long to form roots that they often dry out first. Among these the best known example is the naartje, which is often propagated in this way, quite large and branched branches being often used in this case. The large size used is, however, objectionable, since the amount of root formed even within several years is not in proportion to the growth maintained, while as a result of this short nourishment supply the endeavour to perpetuate an unhealthy plant results often in an abnormal production of poor fruit, at the expense of the vegetative growth, and a consequent small unnatural growth for years. A small layer produces roots proportionate to itself, and makes a better tree eventually, though it misses the first few poor crops; but in the case of the naartje, even a small layer, which, of course, has naartje roots, is not equal to a naartje budded on a more vigorous rooted stock.

Layering is sometimes done on high branches by attaching soil around the branches instead of bringing the branch to the ground. This is done, after the usual cut is made, by placing a tin or bag around the cut part, firmly supported, and filling with soil, leaving, however, sufficient room for necessary watering (Fig 19b). Split sections of bamboo are often used; they are easily applied, and found large enough in moist localities. Magnolias, Ficus, mango, etc., may be propagated in this way. Some plants which have a tendency to root at the joints or bud strike as layers if simply pegged down into the ground without any cut being applied; this is usually what is done for the propagation of bamboos, though not always successful.

Suckers and Root-Cuttings.—Many trees have a tendency to produce suckers, i.e., branches leaving the stem under ground, and coming above at some distance from it. Such suckers almost invariably root easily if separated from the parent, though in many cases, as, for instance, the White Poplar, Cherry, Plum, Apple, and Pear, cuttings of the

branch-wood formed above ground by these same trees do not readily strike.

Many other trees have a tendency to produce buds upon the roots themselves, and, under provocation, to develop these into independent trees. By this, I mean that if the roots are deep and undisturbed, they do not naturally do so, but if they happen to become exposed, or more particularly, if they are bruised or cut through, the portion exposed or separated from the parent starts an independent life, and produces a stem of its own. Blackwood (Acacia melanoxylon), Silver Wattle (Acacia dealbata), Casuarina Stricta, Wych Elm, Cork Oak (Quercus suber), etc., may be mentioned as examples, but it is to be noticed that such plants having usually a large root system attached to a small plant, do not transplant so readily as suckers, and are, indeed, in many cases difficult to transplant. But in other cases, including the Hawthorn, Quince, Japanese Quince, Rasp, etc., cuttings of the root, an inch long, without buds, set in sand in a propagating house, callus and produce buds (Fig. 18), and eventually develop good plants, and probably this would be the case with all those named above if proper appliances were at hand. Sometimes the cutting is simply a section of the stem, but more frequently, it is also cut lengthways, so as to expose more cambium.

Buds, Grafts, Inarching, etc.—Propagation by these means is so distinctly connected with fruit culture, so far as Natal is concerned, that they hardly require mention here. Still, their use in connection with the propagation of ornamental trees, such as Maples, Conifers, Weeping Varieties, etc., is common in Europe, and sometimes even scarce forest trees are increased in this way.

The one thing necessary is that the cion or bud be sufficiently akin to the stock to allow a connection, for the yarns sometimes told about budding successfully, Oranges on Pomegranates, and Roses on Oaks, bear evidence in themselves that they are untrue.

Conditions necessary for success with cuttings.—These are:—

(1) That the soil be light, porus, and well drained, keeping moist, but not liable to saturation.

(2) That the atmosphere be close and moist, cool, and not libale to change either as to temperature or moisture.

It is also of advantage to have the soil warmer than the atmosphere if it can be managed. Here, that is managed most easily by having the cuttings set in autumn, while the soil is still warm but the atmosphere begun to cool. In other countries it is managed by special appliances, which allow the regulation of the soil-temperature, and consequently allow the extended use of cuttings, and especially of soft-wood cuttings, as a means of propagation.

The simplest and most common of these is the hot-manure frame—a wooden box with a glass cover, and set upon a pile of stable manure, fermenting to an extent sufficient to raise heat which is maintained and regulated by additions of manure outside the original pile—the surface of the manure being covered by a few inches of soil, in which the cuttings are set. In Natal manure containing litter is scarce, and is so apt either to dry or to burn that its use for the purpose of raising and maintaining heat has not been successful, and is now abandoned. A more likely success here, at present, is to place the frame on the top of a silo stack. In all European and American nurseries a properly arranged propagating house is, however, considered a necessity. A cool atmosphere is obtained by having it placed in a shady spot, and facing away from the sun, while heat is raised in the soil by means of hot water pipes built into an enclosure, the top of which is of thin sheet iron, or slates, supporting three or four inches of sand in which the cuttings are set to be rooted. The object of a cool atmosphere and warm soil is that budgrowth may not be encouraged until the sap, attracted by the warm sand, has formed a callus and begun to form roots, which themselves supply the nourishment to push the buds into growth. Of course, cuttings cannot draw much nourishment from pure sand, and cannot long thrive in it, but the first object is to form roots, and once these are formed, early action has to be taken towards having the cuttings replanted into richer material which will maintain life. Once the cuttings have extended their roots freely into this material they are ready for hardening off by exposure, and ultimately placing outside, even though top growth has not then commenced.

As already mentioned, this is a tradesman's work or an amateur's hobby, and is not yet common in Natal, but the raising of hard-wood cuttings in the open air, or under slight protection, is simple and sure with regard to a good few kinds, especially of shrubs, and requires no technical training to make it a success

CHAPTER IV.

THE PLANTING OF TREES.

The first consideration in connection with planting trees is to decide definitely for what purpose the trees are to be planted. They may be put in singly as ornamental specimen trees, or more thickly as shelter belts, or still more closely for the production of timber for economic purposes. But as the treatment is different for each of these classes, it is necessary at the start to decide which is to be adopted, and to act on that decision. In many cases an endeavour is made to combine the three, and to produce at once timber, shelter, and ornament, but success in this is very seldom obtained. Indeed, the methods of producing these three classes are incompatible, and it is only in extensive grouping effects that shelter and ornament can both be produced from trees satisfactorily grown as timber trees.

Ornamental trees are seen at their best when planted widely apart as single specimens. It matters little what the species is, for every species is ornamental when seen as a well-grown single specimen. Every branch is then fully developed; abundant canopy is produced at the expense of height; a rounded bushy crown feathered down the stem to the ground is produced, while, the stem itself as well as the branches are of much greater diameter than where the trees are standing more closely. Everyone is familiar with the beautiful umbrella-shaped Black Wattle tree standing alone in a grass paddock, and knows how different the form there is from that assumed by the same species when grown closely for bark-production. But the spreading, bushy, branched habit is all wrong if economic timber is wanted. Every one of the branches represents a knot in the timber, proportionate in size to the size of the branch, and usually extending to the core. Such knots render the timber of no economic value except as fuel, and difficult to split up even for that. This applies to every species, and is the very reason why British timber is now excluded from Public Works contracts in Britain, the trees being more usually planted wide apart there for game-cover than close enough for timber production. Sometimes, also, an endeavour is made by artificial pruning to remove the branches, and so produce a stem fit for sawing up, but this is always an expensive operation, and except done frequently when the branches are young, it does not have the desired effect. Indeed, the only sure preventive against knots is to plant the trees so closely that by natural crowding only the uppermost branches have light and space enough in which to grow, while those below die off without attaining such size as well injure the tree for timber purposes. How

closely that is differs with species, but for most kinds five feet apart each way is about right; in some kinds of branching habit, such as Pinus halepensis, even closer planting than that is desirable, and in a few rapid-growing and equally unbranched kinds, such as Eucalyptus citriodora and E. macrorhyncha, greater space, up to ten feet each way, is permissible. But the intention is for timber production to produce straight boles without heavy branches; and for this purpose the trees have to be planted closer than they can stand when mature, the superfluous trees being removed from time to time as found necessary, but enough left at all times to keep the canopy dense and the trees crowded rather than otherwise.

Grown in this fashion, the individual tree is not ornamental, though viewed from a distance the mass of trees may be so.

It will be seen, then, that an ornamental tree very seldom is a tree fitted for economic timber production, and *vice versa*. It is common practice here to plant sparsely, and then as the tree nears maturity to lop off branches nearly as mature as the bole itself; how miserably this fails in accomplishing its end is illustrated in Fig. 21, in which a tree grown as an ornamental tree, the same tree with its branches lopped, and another tree grown in close canopy are shown together, along with the timber-log produced by each. It is this sparse planting which has produced the erroneous impression that trees grown in Natal plantations are fit only for fuel or props; such is not the case if kind and culture be correct. It is also the rapid growth produced by sparse planting which has made properly treated timber plantations appear slow in growth, and consequently unsatisfactory, for it must be admitted that the individual trees in a sparse plantation make timber faster than those in a dense one, while the consequent fact is usually overlooked that the trees in the sparse plantation yield fuel and props as thinnings, but have full timber value when mature.

For shelter purposes an intermediate degree of closeness is best, but the density must always vary with the site, the kind, the purpose, and the distance the shelter is away from what has to be sheltered. Sufficient space is necessary to allow branches to grow and remain healthy, for a bare stem gives no more shelter than a flag-pole; but, on the other hand, if trees are sparse enough to make individual specimens the windbreak is usually incomplete. Shelter belts for the protection of homesteads are often placed too near the buildings to do much good; indeed, usually a homestead is immediately surrounded by trees, and so rendered close and uncomfortable, while there are no trees at all a short distance away where the trees ought to be on purpose to provide an efficient and unobjectionable windbreak.

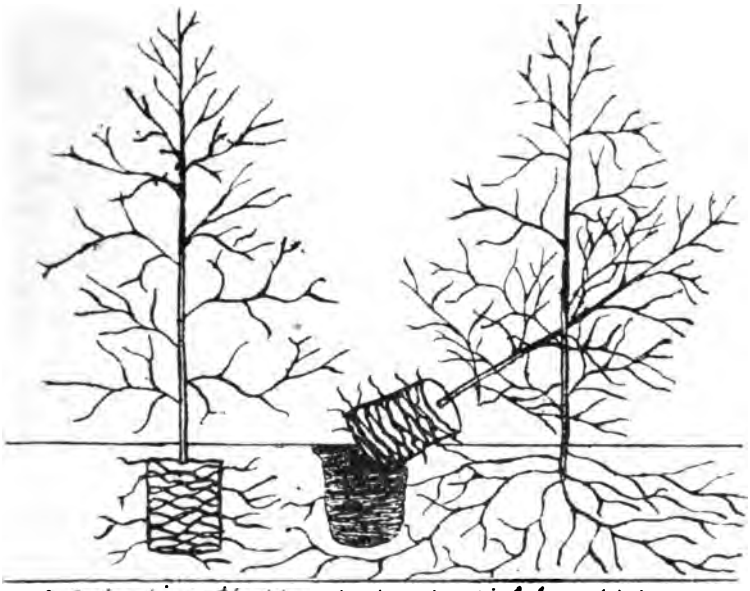
Having decided on the object of the plantation, the site follows as a natural consequence. If for timber production,

of course, any site suitable in regard to soil, shelter, aspect, and moisture will do, but if for ornament or shelter purposes, these objects dictate the site, often in opposition to all requirements of the trees themselves. Then, indeed, has the planter to exercise his ingenuity in making trees thrive in an unsuitable site, and in so selecting kinds and positions as to produce a happy and effective whole out of a number of incongruous items. No instructions can teach this art, it must be developed naturally, by the application of common sense. or else learned by bitter experience. The preparation of the soil is of considerable importance; more so, indeed, than its composition, although it is desirable for almost all trees to obtain an open well-drained soil of reasonable depth and overlying a porous subsoil. The soil requirement varies, however, with species, but from all species best results are obtained if depth and drainage are provided, either naturally or artificially. Where the subsol is impervious, it is, however, useless to provide depth into that, as the only result of digging a pit into such a subsoil is to form a basin in the subsoil into which all neighbouring moisture will drain to the extent of drowning the roots and rendering the soil sour. But even though the tree be not drowned out, the practice is objectionable since a pit of prepared soil is more easily permeated by roots than the surrounding harder soil; the earlier roots consequently keep within the pit, and do not extend outward, and it is only in after years that they extend far beyond the pit. Now the result of this is that the tree forms a mass of roots within the pit, but has no support from the outside; even when the roots extend outward in after years, the support given by them is counteracted by the coiled and spring-like main roots in the pit, and if a gale of wind strikes the tree at a time when the soil is saturated, the leverage from above is more than the roots can maintain, and the tree falls, bringing its roots out mostly in a ball the size of the original pit. Fig. 22 shows approximately the relative root-development in the cases of a tree planted in a pit, and one planted without a pit, and also the method in which a pit tree gets blown over.

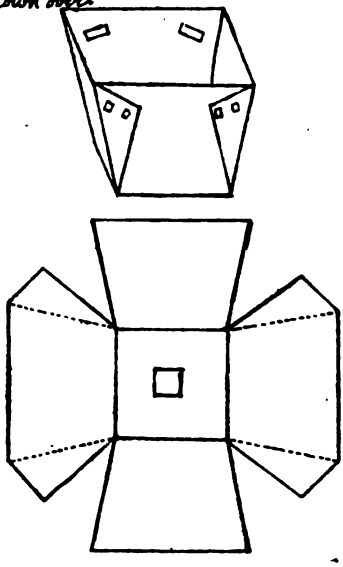
The best preparation is by having the soil ploughed, cross-ploughed, and subsoiled; this makes it all equally porous and open for root-growth, and is suitable alike for planting or for sowing, the only further preparation in the case of sowing being to have the surface sufficiently pulverised to suit the seeds.

When extensive operations are in hand preparation of this nature should be adopted; indeed, everywhere it is the best except for rocky ridges where the plough cannot be used, or for single trees planted so widely apart as to render the method impracticable.

Where ploughing cannot be done on account of rocky surface or steep gradient, hoeing by Kafir hoe or pick is the such a substitute, the idea there also being to have the whole



22. Comparative root development of trees planted in holes and in open ground showing how the former gets blown over.



23. Effective Tree-guard.
24. a. Flat tin cut to form plant tin. b. same, completed.

surface equally prepared, and even though the preparation be not so deep as to loosen the soil where the roots will actually be, it is still sufficient to collect and transmit moisture, and by its dust-cushion action to retain the same, and thereby render the substratum more suitable for root-development than it otherwise would be.

In some rocky situations it is quite impossible to prepare the whole surface—even by hoeing—in such cases small spots should be prepared by pick, but these must not be large enough to supply a season's root-room; indeed, they should only be large enough to allow planting, and the roots are thereby forced to at once fight their way for existence, or else die, and a large proportion of deaths must always be expected in this class of work.

Where a solid subsoil on a fair gradient is covered by little surface soil the depth can often be increased by removing the clay or rock subsoil over a considerable area, taking it away, or at least breaking it loose to a greater depth on the upper than on the lower side so as produce a level base, or one sloping slightly outward to allow of drainage, and sometimes even in hard rock it is considered worth while for special purposes to form by blasting a sufficient hole in which to place soil and plant trees, taking care, however, that there is also formed an open channel or stone drain through which drainage can escape.

Where it is absolutely necessary to use single holes the size of these should be as large as possible, and the depth not greater than the surrounding loose soil. The writer who states that for orchard work the prepared hole should be the whole size of the orchard has closely hit what is also necessary for forest tree culture. This, of course, is produced by ploughing and subsoiling, also to a limited extent by Kafir hoe work, but for street tree-planting and for planting specimen trees around homesteads, it is still found necessary in some cases to prepare individual pits. Six feet by six feet by two feet depth is none too large for these; if greater depth is considered necessary, that should be filled up with loose stones rather than with soil, and only two feet of soil placed above with a layer of grass or turf between. The small holes one foot cube, so often seen, are all right if the whole surface has previously been equally prepared, but are entirely wrong if they are the only prepared spots in an otherwise hard surface.

The soil having been prepared by one or other of the above methods, it should then be fenced, for it is a waste of trees and labour to plant unfenced ground. Such fencing as protects grain crops should be used for all extensive work, for however rapid the growth, it is useless to consider a poor temporary fence sufficient for tree-planting, in the hope that trees will rapidly outgrow the need for protection. Whatever the kind, several years must elapse before trees do not

require protection from stock, and the difference in cost between an efficient and an inefficient fence is too small to justify the use of the latter. Wherever trees are too scattered for a fence common to several the use of individual tree guards should be adopted, the simplest and most effective of which is composed of three uprights connected and kept apart by slats at the top, and surrounded by coiled barbed wire fixed by a staple wherever it crosses an upright. (Fig. 23.)

A guard composed of similar standards, surrounded by 2-inch netting, is also effective and durable, the weak points in most tree-guards, especially in towns, being undue expense or liability to be climbed upon by children, or removed piecemeal for fuel. Some extraordinary tree-guards are to be seen, as for instance, at Naauwpoort, Cape Colony, where stock, dust-storms, and cold have alike to be provided against, and where discarded iron pot-sleepers are the only material used except when these are enclosed in sacking during winter.

The preparation of the trees has been described in a previous paper, and the condition when ready for planting mentioned. Generally for evergreen kinds, such as Gums, Pines, etc., 20 to 30 trees are grown together in one tin, and sent to the field in that form. Deciduous trees are usually grown in open beds, and the roots packed in grass or soil, surrounded by sacking, when sent out to be planted. Specimen trees are more usually grown to a larger size in separate tins.

For extensive planting, the two former classes are preferable, the evergreens doing best when from three to nine inches in height, and the deciduous trees when only one year old, or when two years old if they have been transplanted in the nursery during the previous winter. Deciduous trees require to be planted when leafless during winter; other kinds may be planted at any rainy period of the year, though preferably in spring or early summer, as that season allows them to get a good start before the first winter. With evergreen kinds short stout plants are preferred to long and lanky ones; the latter stand upright in the tin through natural support, but are unable to stand erect when planted singly, consequently they fall over, and, instead of making an erect leader, as in the case of the sturdy transplant, they branch from the base, and form a spreading bush, which takes a year to produce a good leader. (See Fig. 28.)

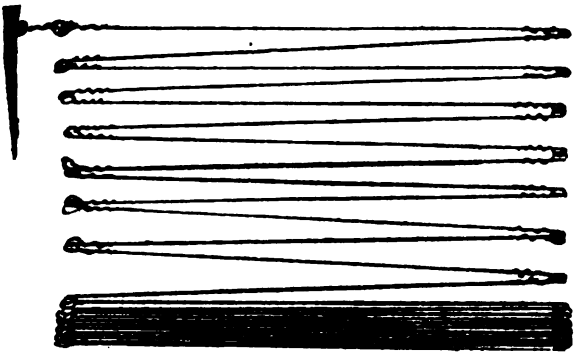
Assuming that an extensive area has to be planted, and that the ground has been prepared, as already described, by ploughing, and afterwards harrowed fine, the simplest method of placing the trees regularly is by means of a planting chain Such a chain is formed of light galvanised wire—about No. 12 gauge—cut into lengths slightly longer than the distance apart at which planting is to be done. These lengths are then joined together end on end by a loose loop, so that when stretched the joint indicates in each case where the tree should stand. Such a chain, if well constructed, can be

used by a gang of the rawest Natives without mistake, leaving the trees planted in straight lines in every direction, and at equal distances apart. But unless they are carefully made, two chains seldom correspond exactly, consequently it is better to use only one chain at a time for a gang of planters, even though they do have to wait a little while it is changed, rather than use two chains, one of which is being set while the other is being planted. One hundred yards is a convenient length of chain to work, though, of course, it may be used at any length which can be conveniently stretched, and the loose joints allow it to be folded up and put past when not in use. Fig. 25a shows the chain while being folded up; Fig. 25b shows it stretched, and the work produced by its use, the two end lines having been planted first as guides to where the cross lines should go. These chains are not on sale, those used by Government having been made to order by Mr. Ford, Chapel Street, Pietermaritzburg.

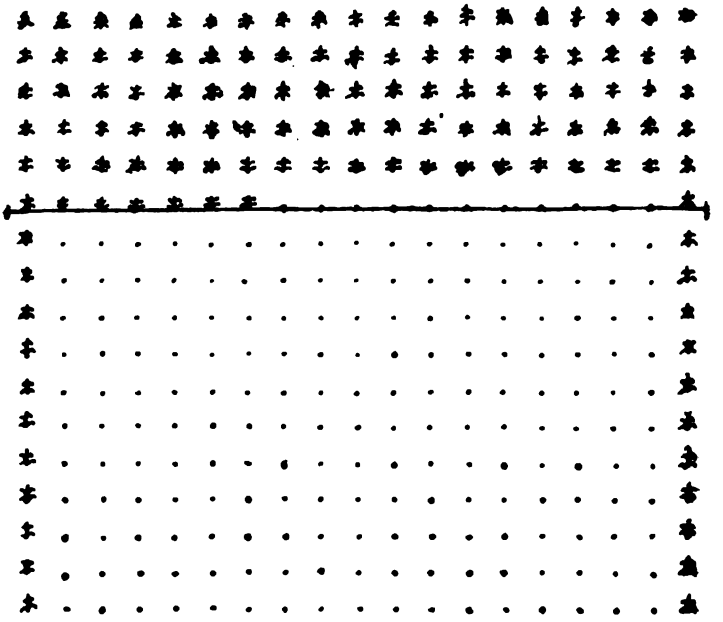
When only a small area is to plant, a similar guide composed of string knotted at the fixed distances may be used, though that is liable to change length when it gets dry or wet.

The method of removal of the trees from the tin and their being planted in the ground is shown in Fig. 6 c. d. ("Agricultural Journal," February, 1904). Each tree is taken out separately with the trowel, only just when wanted, and after a small hole has been prepared with the trowel for its reception. The ball of soil containing the roots is thereby kept intact, and even if some wandering roots extend beyond the ball they are planted so soon after exposure that they do not suffer, or feel the change. The soil in the tin should be neither very dry nor very wet, though the latter is better than the former. When the plantlet is placed in the hole, the roots should, so far as exposed, be spread out, to give the first main roots radiating positions, and thereby secure support for the trees on all sides. Soil is generally filled in by hand and pressed firm by the fingers, the tree eventually standing with the soil-level at the same part of the stem as before it was transplanted, and a slight depression left in the soil to contain water. Unless it is raining at the time, a liberal supply of water should be given at once—enough to settle the soil among the roots and keep it moist till new roots begin to form. Further watering should not, however, be given except under extreme necessity, for beyond the first watering, which is a necessity, any further treatment of this kind tends to make the tree dependent on artificial care and less self-reliant. If frequently watered during the first season the tree does not endeavour to provide for itself, and then dies off or suffers as the supply is withheld.

Deciduous trees require practically the same treatment, except that they can only be moved during winter, and may require to be watered several times before the regular season begins, for though leafless at that season they transpire freely



Jointed Planting-chain; mostly folded up.



Method of using the Planting-chain
Dots in the lower portion showing the regularity produced by any raw native who plants at each joint.

from the young stems, and also dry somewhat by evaporation. They also usually have larger roots than evergreen, and often require holes dug by the spade instead of by the trowel.

Evergreens which are in active growth require more careful treatment than those which are dormant, and during bright weather it is usually preferable to protect such trees under a handful of grass for the first few days after they are planted. Cloudy weather should be selected for planting in, if the number to be planted does not demand work irrespective of weather. Trees which have been allowed to get too large before being planted out may, in most kinds, be brought right by being cut down to near the ground level at the time they are planted out; this, however, does not apply to conifers, Pines, Cupressus, Cryptomeria, Sequoia, Podocarpus, etc.), which, with the exception of Pines less than one year old, do not readily respond to this treatment.

The cross ploughing and harrowing of the soil should in all cases have been but recently performed when planting begins, on purpose to have the soil-condition fit for use by young rootlets, and also on purpose to avoid weed seedlings, which in older preparation usually have some hold.

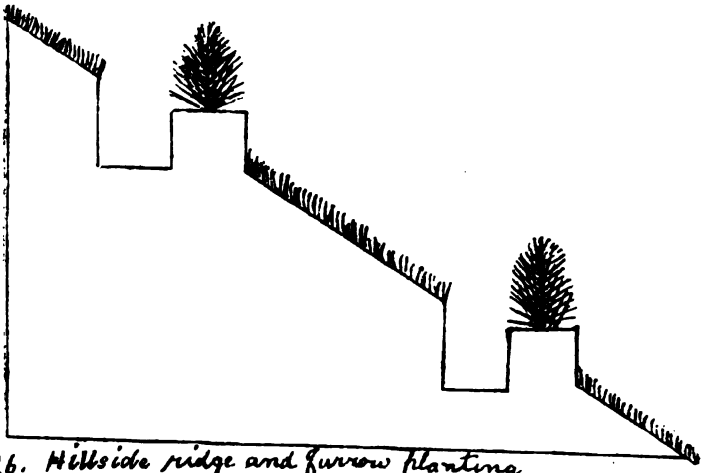
New soil (i.e, previously unbroken veld) is to be preferred for tree-planting to old lands, as the latter are almost invariably fully seeded with annual weeds, which have a tendency to outgrow the trees during the first year, and do damage. New soil has, however, a tendency to produce a growth of grass weeds if the first ploughing has been done during early summer; indeed, the best preventive against this, which is a serious trouble, is to plough late in autumn and to a depth of only three or four inches, thereby exposing the grass roots to the dry winter, and then in early spring cross-ploughing to a greater depth, harrowing off the grass roots at the same time. If the grass can be burned before it is ploughed, so much the better For deciduous trees this treatment, followed by one grain crop and another ploughing is the best preparation. On very steep land, and land far from water, sowing such kinds as can be treated in that way is better than planting.

It used to be the practice on very steep land to prepare ridges on which to plant the trees, the ridges being taken out on horizontal contours, and each formed of the soil taken from a furrow made at the same time immediately above it. (Fig. 26.) In wet seasons this gave good results, as the furrow caught and held any rain which fell until it rose into the ridge, and kept the plants moist, and even in dry seasons it gave more depth of soil for the trees to start upon, and gave regularity and promise to the early growth, but the practice has gradually been abandoned, not only on account of expense, but also because the roots were cut off by the furrow from the soil above, and consequently had a one-sided hold; while the more modern practice of hoeing the whole surface

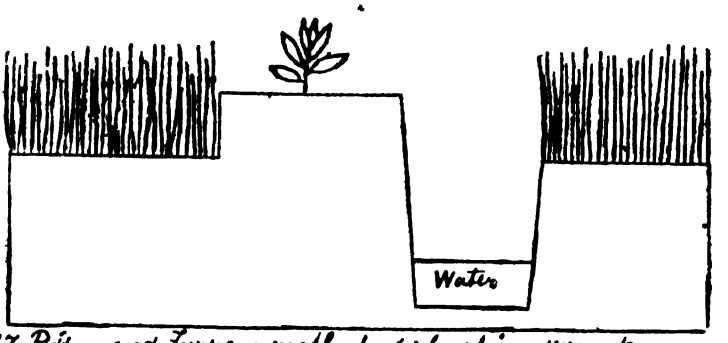
secures the rainfall between the sods to an equal extent, and at the same time allows the roots free play in every direction.

For wet ground, however, the ridge and furrow system can still be recommended, as the tree is thereby set high enough to be out of stagnant water while young; the furrows provide drainage which is effective if they open into a lower main ditch, and if the trees are strong absorbers of water, the joint action of the trees and this surface drainage usually converts a swamp into dry land in a few years, and produces a firstrate timber crop. (Fig. 27.) Soil which is always stagnant, however, and from which there is no cutflow, is more difficult to handle, and may be described as unfit for any kind of tree except Willows or Wild Figs (Uluzi), and these only if islands sufficiently high to be fresh can be formed for the trees to start growth upon. A further exception occurs in the saline swamps near the coast in which Barringtonia and the three Mangroves luxuriate even in tidal mud.

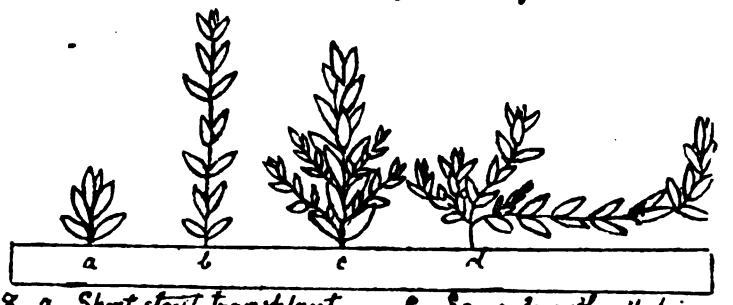
Specimen trees grown in separate tins may be treated rather differently from those grown in stock tins, since each tree has enough root-room to allow it to grow to a greater size, and at the same time transplant with equal safety. Such trees are, consequently, the favourites for planting out singly or for street planting, where large size and an early show are the chief desiderata. For such work a half paraffin tin is none too large, or even a whole paraffin tin with the top removed, as these hold enough soil to keep the tree in health for a year or more, and so allow it an opportunity to grow into size, but the aim should always be to produce rapid growth and plant early rather than to simply keep the tree in existence for several years until it has grown in spite of all hardships. In the latter case the roots are usually twisted round the ball, and useless for the formation of supports, but in a quickly-grown tree the roots are often undamaged and almost unbent. An important point is to use tins which can be opened without injuring the roots, and this can hardly be said to be the case with regard to the paraffin tin, which has to be cut open, except in the hands of an expert, when the soil may be slipped out gently, leaving the tin uncut. Both operations require practice before injury to the roots can be avoided. A smaller tin which is in common use in nurseries, is formed from flat material by cutting as in Fig. 24 (a), and then folding up the sides and folding in the ends as shown in Fig. 24 (b), fixing all in position by a tin catch on each side. This form of tin can be opened out flat without interfering with the ball of roots, which can then be either planted intact or opened and spread out as may be considered best. Trees grown to some size in separate tins usually require to be fixed to supporting stakes as soon as they are planted, and kept staked for several years, though smaller trees planted out from store-tins seldom require support, and are better without it if it can be done without. Trees grown



26. Hillside ridge and furrow planting.



27. Ridge and furrow method of planting swamp.



28. a. Short stout transplant. c. Same, 3 months after being planted
b Long lanky transplant d. Same do do do do.

in separate tins are usually so accustomed to a daily dole of water that they require this to be continued after they are planted, but the supply should be reduced rapidly as soon as fresh roots begin to form into the surrounding soil, and withheld entirely within a month or two.

Large deciduous trees several years old are also used for street-planting, and for similar work. If these have been transplanted regularly in the nursery during each winter there is no difficulty in transplanting them again, but if the taproot has never been previously disturbed a large tree usually suffers from being removed. Many kinds, especially deciduous kinds, make a fair growth during the first year, but afterwards make no further progress, and appear bark-bound or unhealthy. In such cases, if the roots are alive and active, the best practice is, in many cases, to cut the main stem down to within three inches of the soil, leaving a clean surface to the stock from which one or more coppice shoots will start. All should be rubbed off except the strongest one, which will then produce a main stem of rapid and healthy growth.

CHAPTER V.

THE CARE OF PLANTATIONS.

It is not an uncommon experience to find that trees are expected to look after themselves from the date of planting, onward. Generally speaking they are quite capable of doing so, provided every operation has been correctly performed up to that point. That is to say, if the plantation has been ploughed and prepared in such a way as to preclude a growth of weeds during the first three seasons, if it has been fenced in such a way as to prevent trespass of stock in perpetuity, if it has been planted sufficiently closely to cause a struggle for existence and yet sufficiently sparsely to secure the survival of the fittest, and if in the case of inflammable kinds like pines, a clean firebelt in correct form. But such case is too hypothetical for actual practice; it never does occur. Consequently care and attention are in every case a necessity, usually for several years, often as long as the plantation exists, and any condition in a timber plantation, which admits fire at any time or stock trespass while the branches are not above the reach of cattle, can only be set down to negligence. A plantation planted or sown before it is fenced, is in a fair way to destruction, for good intentions often fail, and other operations considered more important may keep the erection of that fence for many years on the agenda, or at least until the plantation has disappeared.

So also the protection against fire must be not only intended, but actual. But the labour connected with this varies with the preparation of the ground, and the consequent condition of the stock. With non-inflammable kinds, like Gums (Eucalypts) and Wattles (Acacias), a soil surface clear of weeds secures the condition which fire cannot enter, and in that case a clear space of five feet width between the trees and adjoining grass prevents damage further than the occasional scorching of the leaves along the outer margin when the grass happens to be dense, and the wind strong at the time of burning, though a wider clean firebelt is always desirable. But in the case of pines, it is not only desirable but absolutely necessary, since these trees burn easily even when green, and fire can pass through a whole pine plantation flaring among the branches without touching the ground, but leaving almost complete destruction in its wake. Twenty feet of clean firebelt around the perimeter is none too much for these trees; more, indeed, is better, and this must be maintained in clean condition till the trees are naturally devoid of foliage for the lower ten feet, which seldom happens within ten years. By that time shed leaves again begin to accumulate under the trees and constitute a danger from fire,

and therefore render the continuance of a clear outer belt necessary, almost in perpetuity. It is, however, as protection against fire that close planting tells most readily. Take the case of Black Wattle; that tree is not naturally inflammable, and if sown so as to produce a dense crop, it does of itself destroy whatever weeds may have survived bad preparation of the land, and, therefore, secures a fire-proof condition. But such close crop does not grow into timber so rapidly as a sparse crop, consequently the latter is usually preferred even with its attendant danger from fire, and the result is that many plantations have suffered great injury from this cause. In the case of Eucalypts a dense plantation is practically clean and fire-proof, and in the case of Pine, a dense plantation rapidly clears itself of branches and thereby reduces the danger, whereas a sparse plantation not only grows a crop of inflammable weeds, but maintains its own easily ignited foliage to the ground till burned out.

To what extent firebelts should be formed inside a plantation, or how they should be formed, must depend on local circumstances. If the trees employed are naturally non-inflammable, and the crop is sufficiently dense, the advantages of internal firebelts are not apparent; the whole plantation is in reality one complete firebelt, and a road left open, as is sometimes done, does not increase the safety, but rather, unless the road is regularly kept clean at considerable expense, tends to diminish it. Such a road, if it is to be ultimately required for harvesting purposes, may be marked out before planting commences, or a four-foot path may be formed, but the crop of trees should be continuous and complete until the trees are mature, when those forming the road are naturally the first to be felled. But if, on the other hand, trees of an inflammable nature are being dealt with, wide roads clear of trees and continuously kept clean are necessary, so that if fire should happen to get in the roads may form barriers, or at least points of vantage from which the spread of flames may be controlled. And, though it has not hitherto been done to a large extent in South Africa, it seems preferable to have such roads made double width and occupied with a non-inflammable kind of tree, densely planted, than to have them left empty, this being not only on account of the expense of, and frequent tendency to neglect, cleaning the paths, but also on account of the foliage on the trees acting as a more complete firebreak than an open space does.

And again, if it is desirable for any reason, or if by previous mishap it cannot now be averted, that a plantation is sparse, it becomes all the more necessary to have clean belts either outside the plantation or under the trees, in order to prevent the entrance and limit the spread of fire.

With a sparse shelter plantation, or even a widely planted ornamental plantation, a very opposite method of

arriving at the same end is often the best. Fencing is quite as necessary in this case as in the other, but after the first three or four years it is on purpose to keep stock in instead of to keep them out. That is to say, the plantation must be kept clean by hoe or plough until the trees are beyond the reach of sheep, and thereafter the plantation must be used almost as a kraal, or at least sufficiently grazed down by sheep to prevent fire being possible. Cattle and horses are not suitable for this work, and goats should be rigidly excluded all times and under any conditions, but if fenced for the purpose and sufficiently stocked fowls keep the grass down even more closely than sheep. Sometimes the recommendation is given to plough between trees while they are young, and by cultivation induce more rapid growth, just as happens in a mealie field. Such an effect is actually produced, but trees are more perennial than mealies, and the after-effect has also to be considered. Trees taught by early habits to rely on cultivation for moisture produce their roots mostly near the surface, which soon becomes a root-bound mass, while deep self-supporting roots are less common. Trees which have to battle with circumstances from their earliest youth soon develop independence, their roots wander far and find whatever suits them, and the consequence is that during any period of neglect, or drought, or other unfavourable factor, they hold their own better than the trees cultivated in youth.

For timber forests, then, natural conditions are preferable to the artificial, although the growth is naturally slower for the first few years.

Pruning is not a natural operation. In nature, forests are usually so dense that branches die off before they attain size, hence straight clean stems without knots, such as we see imported from the Baltic or from Canada. Where natural forests are rather sparse, as is unfortunately the case in most South African natural forests, heavy much-branched crowns, spreading from short boles, are only too common. In plantation work this is avoided by closer planting, and, theoretically, pruning should be an unnecessary and unknown operation in timber production. The only trees which should have branches are those along the outer margin of a plantation, which should remain branch-clad to the ground on purpose to enclose the moist forest-atmosphere, and to exclude dry winds. In actual practice it is, however, often necessary to do a certain amount of pruning, especially in the way of removing double leads. But, as I have shown when dealing with Black Wattle, there is also an advantage to be had in pruning back to the extent of securing uniform height and vigour throughout the crop; and if that is the case in regard to black wattle it is more so in regard to other timber crops, in which trees lasting, say, fifty years, dominate their neighbours during the first years and progressively more each year afterwards.

So bad is the effect of an irregular start that it is sometimes necessary, even with Eucalypts, to completely fell a whole crop after it is three or four years old, and thereby secure an equal and almost invariably a better and more clean-stemmed stand of trees from the coppice-shoots. Eucalypts respond to this treatment safely, even when they are many years old, if carefully handled; Wattles (Acacias) do so with sure results while they are young, but in after-life are apt to produce heavy coppice-shoots connected by the cambium only to one side of the stump, and so liable to be blown off; Casuarinas usually coppice freely, and most deciduous trees do so, but, with few exceptions, pines and other conifers do not coppice freely, and in many cases never coppice at all after they are three or four years old. Where pruning is necessary it should be done before the branch has attained large size; indeed, topping one year old shoots is much better than removing five year old branches, but when the latter operation does become necessary, the wound should be cut clean and dressed with an antiseptic. That this is necessary to prevent the entrance of fungus-spores is amply proved in the large number of Blackwood and Oak trees destroyed by fungi which have gained admission and foothold on badly pruned and undressed knags.

Nature pruning (i.e., the natural death of small branches through close planting) offers the only reliable guarantee that the operation will be continuous, inexpensive, and free from concomitant disease; and wherever timber is wanted it is the method to follow. Where shelter or ornament is desired, of course, pruning is not required, as the more branches the better for either of these purposes.

But even nature-pruning can be overdone. Each tree requires a certain space for its foliage as well as for its roots, and if the crowded condition goes beyond the minimum for the species, the tree naturally suffers or dies. The minimum varies with the species, but in every case the planter has to watch his local conditions and thin out trees whenever necessary. Frequent but light thinning has better results than occasional heavy thinning; in the former case each tree is required to maintain canopy, and given no more room at a time than it can rapidly occupy; in the latter case the canopy is for a time withdrawn, an undue weight of crown is encouraged on a weak stem, and not unfrequently a windstorm does enormous havoc after such thinning, though it can get no hold upon a lightly thinned plantation.

How closely some kinds can stand till maturity is very noticeable in the suburbs of Capetown, where Cluster Pine (*pinus pinaster*), and Stone Pine (*pinus pinea*) form fine boles only a few feet apart, though nearly or quite mature. When thinning becomes necessary it is usually better to remove the poorer stems, even though they have not even firewood value, and thereby give the best a better chance, than to remove the

best when they have only just begun to be of value, on purpose to give a chance to their poorer neighbours, which are not in condition to avail themselves of the opportunity given. In the former case nothing is lost by the removal, and an early result shows on the best trees, which rapidly come into value; in the latter case what little value there is is sacrificed for a doubtful advantage in the distant future. This holds good up till the best trees reach their stage of economic maturity (which varies with species and surrounding conditions of locality, market, labour, etc.); but after that the process is reversed, and if the plantation is not in condition for clean-felling, it is then the mature trees which are felled, leaving the others to mature if they can, or at least to benefit as far as is possible by the removal of their neighbours.

Where more than one kind is growing in a plantation it may be necessary to remove one of the kinds earlier than another. Thus some kinds—as, for instance, *Pinus halepensis*, and *Acacia Melanoxylon*—are, to a considerable extent, shade-bearers, that is, they can endure to be grown under trees which more or less completely close over them. But though they endure to live and grow, they can hardly be said to thrive under such condition; and so it happens that if the dominating tree has arrived at a stage where it can be turned to some economic use, such as props or even firewood, an advantage may accrue to the plantation as a whole by the removal of the dominating crop, either all at once, or in several instalments, and the liberation of the previously dominated trees to grow into timber. Mixed plantations cannot, however, meantime be recommended. This is not because mixture is not natural, but because tree-growth is such a slow process that South African experience has, thus far, only reached the stage of knowing what mixtures are failures, and these, unfortunately, include most of the mixtures that have been tried. Pure plantations (i.e., plantations of one kind only), have usually been successful, probably on account of the growth being equal, and therefore none of the trees dominated; but it is also noticed that in localities which are natural forest sites almost any mixture is permissible and trees thrive in luxuriance, which in a less suitable or more sunny spot would assuredly die if given the same sompanions.

Felling by gradual selection is hardly to be recommended after a fair share of the trees have reached maturity. It is generally better to completely clear the section, and thereby give an equal chance to all re-growth which may show itself, even though this necessitates the removal of a good many trees in an immature or damaged condition, for it must be remembered that if left standing these trees are isolated by the general clearance, and are then more liable to damage than formerly, while the felling of these trees after re-growth has made a good start is likely to result in much injury to the succession crop.

In our natural forests succession crops are continually coming on; seed-bearing trees are abundant, and the canopy is unfortunately usually open enough to allow seedlings to germinate and push their way into the light, except where Lemonwood is abundant, in which case the canopy is too dense for almost any seedling to do well, and the result is that Lemonwood is neither killed out nor crowded into form, it takes possession and holds a monopoly. In plantations, however, we deal mostly with kinds which do not endure heavy shade when young, and even though seed and seedlings are abundant the young saplings soon disappear. It is evident they require a good deal of light while young, as well as surface moisture, which is apt to be drained out by the old trees as long as these stand.

Felling by gradual selection usually admits enough light to encourage a growth of forest weeds which retard rather than assist the succession crop; complete clearance on the other hand admits too much light for forest weeds, and if the ground has been sufficiently seeded a succession crop of trees starts at once, equal all over, and only requires weeding during the first season. Of course, all kinds are not alike in this; some kinds never appear to be sufficiently at home to yield a seedling crop, but with kinds which can do so, the above is the case.

An idea exists in many quarters that irrigation does good in a plantation. That this is occasionally the case is not denied, but generally more damage than benefit results from irrigation. If the supply of water is in one constant stream, flowing year by year without intermission along the brow of the hill, so that drainage from it can constanly occur, then usually the trees alongside that stream make more rapid and cleaner growth than those not so supplied. But if by irrigation is meant the occasional soaking of the ground, alternating with periods of drought, the chances are all against lasting benefit. It may occasionally do good to saturate an area when the soil has become so dry that defoliation of evergreens is taking place, but if the watering is done with any frequency or regularity the trees depend on it, and die off as soon as an occasion of watering is missed. Irrigation must be either done without altogether, practised regularly, or brought into use only as a last resort, unless it is to leave bad as well as good effects.

Drainage, on the other hand, is often a necessity. Although drainage ought to take place before a plantation is started rather than while it is growing, it is still an operation which may be brought into use as soon as the need for it becomes evident. Sometimes soil appears reasonably dry for a good many years in succession, and then, by a change in the weather cycles, become as regularly saturated. In such case if the trees themselves are not sufficiently moisture-absorbing to keep the soil fresh, it becomes necessary to form

open ditches to run off any surplus, and by the withdrawal of the water admit air occasionally to the roots, and freshen the soil to the depth at which they act.

After the first few years plantations accumulate dead and fallen leaves, which should not, on any account, be disturbed. These leaves form humus, and add not only to the fertility of the soil, but also to its mechanical condition and power to absorb rain, and maintain for a long period a supply of fresh moisture. A good coat of humus is worth more than any artificial irrigation; it is more lasting in its effects, and has no such danger of after-effect as the irrigation has.

CHAPTER VI.

ELEMENTARY PRINCIPLES OF SYLVICULTURE OR WOODCRAFT.

(Paper read at the Grahamstown Exhibition, 1898, and published in the "Cape Agricultural Journal," March 30th, 1899, and April 13th, 1899.)

Increased sylviculture is one of the pressing needs of this Colony. For centuries sylviculture has been recognised as an art, requiring in its successful pursuit the long-continued observation, and subsequent comparison of facts, bearing on the subject, and borne out in practice, and the deduction from these of the bearing which scientific principles have on the practical operations of, and the theories underlying, success in it.

I do not propose here to go into the reasons why sylviculture should be extended, nor to give details of practice in connection with it, but rather to confine my remarks entirely to the principles abovementioned.

The whole subject is regulated in the first case by the actual life processes of plants in general, and more particularly of timber trees, and since it is only by taking full advantage of these, and giving opportunity for special development in any desired direction, that sylviculture can be successful, a clear understanding of these is a necessary preliminary to further study; for trees, like all other organic beings, are more or less subject to the action of external influences, which produce by gradual evolution special forms particularly adapted for special conditions.

Absorption and Exhalation.—Plants require and utilise food which is absorbed partly from the soil and partly from the atmosphere, and always in a liquid or gaseous condition. Analyses show that the minute individual cells of which plants are built up, have thin enclosing membranes (known as cell walls) which in their chemical composition are a combination of oxygen, hydrogen and carbon. In a living plant these cells contain the peculiar protoplasmic sap which is proof of, and essential to, life, and which contains nitrogen besides the abovementioned three elements.

Traces of various minerals are also present in most plants in quantities varying in accordance with the kind of plant and the soil in which its growth has been made. These mineral substances are received into the plant from the soil, through the roots, in solution in the water which has picked them up while filtering through the soil. As the roots have entire mem-

branes through which this water has to pass into the plant, the minerals must be in the exceedingly fine form produced by actual chemical combination with the water, and not simply floating in it. The sap then passes up through the stem into the leaves, which act as lungs, as the expanded surface exposes it to light, and to contact with the atmosphere. A leaf itself is not a solid body, but it is composed of innumerable cells, contained within a covering epidermis, and usually having numerous openings on the under surface (known as stomata, or breathing pores) leading into irregular interstices between the cells inside the leaf. Through these stomata atmospheric air enters the interstices, and comes in contact with the sap contained in the cells, the walls of which throughout the plant are not so impervious but that the transmission of liquids or gases can take place. Chemical changes then take place, by which the surplus of oxygen and hydrogen from the mixed sap and atmospheric air is set free and escapes again, while the carbon and sufficient oxygen and hydrogen to form the proportion required for cellulose (or cell-wall) is retained, as also nitrogen for the protoplasm (or living sap).

This process, which may be described as breathing going on continually, but more especially under sunlight, liberates an enormous quantity of oxygen and hydrogen (or water) which to allow the process to continue has to be replaced from the cells below. These again draw on the roots, and the roots draw on the surrounding soil, so that a constant pumping action is produced, which proceeds the more rapidly in accordance with the increase of exhalation, which again is greatest under strong light (if the number of stomata be equal); hence plants in such a warm and clear atmosphere as that of this Colony can absorb and exhale a much larger amount of moisture than they do in a climate like North Europe; and as all this additional exhalation carries along with it the fixture of a larger quantity of organic elements in the plant (as well as the inorganic) it follows that growth and wood formation is much more rapid, and that this increases in proportion to the amount of foliage exposed to sunlight.

In all ordinary timber trees the sap after undergoing the processes above-mentioned in the leaf, whereby it is reduced in quantity, but increased in quality, passes back into the stem, and finds its way partly into a layer of soft young tissues known as the cambium layer, placed between the timber and the bark, and partly into the young growing buds. These are the two centres of active growth, that in the bud being mostly in the nature of expansion forward, forming new stems by the addition of length, while that in the cambium layer is mostly in the nature of expansion outward, giving increased timber by the addition from the inner surface of the layer of a fresh ring of timber surrounding those formed in previous years, and also giving from its outer surface a fresh ring of bark inside those

of previous years. The actual formation of timber in each case is by a process of sub-division of the cambium cells, and the subsequent increase to normal size of the small cells formed by this sub-division. All this increased amount of cell-wall utilizes the additional cellulose supplied by the leaves, hence if that supply be large the increase in timber goes on rapidly, and *vice versa.*

It will be seen from the above that though a sufficient supply of water at the roots is necessary to allow the pumping action to continue, and though without that supply the leaves wilt, and the branches become dried out, still it is more particularly upon the supply of carbon and nitrogen that the plant is dependent for the formation of new tissues .

Carbon is absorbed by the plant in the form of carbon dioxide (CO_2 mostly from the atmosphere) through the stomata, and the formation of elaborated sap and cellulose is accomplished by the decomposition of this gas under the influence of light, in the green parts of the plant; its oxygen is given off, and its carbon unites with the sap in the cells, forming what are known as ternary compounds (carbon, oxygen, and hydrogen), which include starch, sugar, elaborated sap, and cellulose, all capable of, and subject to, transformation from the one to the other by slight natural changes.

Nitrogen is abundant in the atmosphere, but in a form which is not acceptable to plants, and it is only when in combination with other elements, (as in ammonia or nitrates) that the plant receives it, and then mostly through the roots. The nitrification of the soil is also accomplished by bacterial agency under a process known as "Symbiosis," in which certain leguminous plants play such an important part that we may infer that Acacias, Robinia, Gleditschia, and other allied trees assist to enrich the soil in this manner more than the other non-leguminous trees.

Plants possess a remarkable power of selection with regard to what elements are absorbed by the roots. And it does not follow because a tree is growing in a soil composed largely of silica, that that tree will absorb a large quantity or any quantity of silica, and so also with regard to the various other elements. But with the elements which are essential to plant life, more especially nitrogen, and the minerals, the better the supply in the soil is, the more likely are these to get into the condition in which they can be absorbed; while if any of them are altogether awanting, or present in too limited a quantity, or in an insoluble form, then plant life languishes or dies out. From this circumstance arises in agriculture the necessity for supplying in the form of manure whatever element is wanting in certain soils, or whatever element by continued absorption by vegetable crops becomes scarce. But different plants have different requirements. Thus cereal crops select silica, while most other green vegetables prefer potash, phosphates and nitrogen,

the proportionate quantity of each substance accepted and retained being shown by chemical analysis of the entire plant.

From this circumstance arises the necessity when tree-planting of selecting kinds of trees exactly suited to the composition of the soil, since the nature of the latter cannot be materially changed afterwards. It occasionally happens however that all the necessary elements are present in the soil, but that they are in form or combination insoluble in water, and so cannot be utilised. To remedy this the simplest and most natural cure is exposure to atmospheric action, which in its disintegrating and weathering action gradually reduces most substances to a soluble condition, and at the same time imparts from the atmosphere itself, or from what is floating in it, such necessary ingredients as will enter into combination with the substances already in the soil, and be thereby fixed in fit form for plant use. This accounts for the advantages of tillage, and explains how repeated ploughing and pulverising has a greater effect than can be ascribed to the mechanical operation alone. But to be successful this exposure to atmospheric action must be more than surface deep. Plant roots are in the soil, under the surface, and often at considerable depths, and very rapidly exhaust the supply of certain elements as far as in available form, unless these are constantly receiving additions from outside, or having the supply on hand transformed into a condition in which it can be utilised. Both these are accomplished by "aeration of the soil," which goes on in this way, viz.:—During rain or irrigation the interstices between the particles of soil become filled up with water, and any air that may previously have filled up these interstices is thereby driven out. If the soil has good natural drainage, or is sufficiently drained artificially, or even by absorption by trees this water drains off, and would leave the interstices empty were it not that the vacuum thereby produced acts as a suction pump, and draws the atmospheric air into every crevice, and thereby allows the chemical process known as "weathering" to proceed, and render soluble valuable plant food which previously was in an insoluble condition. The next rain again drives out this air, and on draining away draws in more, so the process proceeds as regularly as breathing in animals, and always with disintegrating, and consequently feeding effect. But if when water is supplied, instead of draining away, it remains stagnant, these chemical changes cease, soluble ingredients of plant food are apt to be floated out to the surface, and washed away, and other chemical changes take place, which have a poisonous effect, causing roots under continued saturation soon to become unhealthy and die.

During the interval between rains aeration continues in a different method, for as the weathering process fixes certain atmospheric elements, and liberates others, these latter again

diffuse themselves into the atmosphere, and are replaced in the soil by fresh and more fully charged atmospheric air.

What I have said thus far applies equally to agricultural and sylvicultural crops, and underlies all successful cultural operations with regard to either, but now comes a distinction.

Humus.—Agricultural crops in this Colony are carried bodily off the ground, and usually sent to market and used in the towns, consequently the soil loses feeding value year by year to the extent of the crop carried off, minus what has been added or liberated by soil aeration, and what has been added as manure. But in the case of a timber crop little or nothing is carried off the ground until the end of the rotation, which may be 10, 20 or 100 years; even then the timber removed consists very largely of carbon, which is always easily replaced naturally by any succeeding crop; but during the course of the rotation an enormous amount of fallen leaves has gone to add to the fertility of the soil, which is thus both in mechanical condition, and in chemical composition, in much better form at the end of a timber rotation than at its commencement. This is easily seen on the bush-covered coast dunes, where a rich black soil a foot or more in depth, and composed entirely of vegetable humus, is sometimes to be found over-lying the pure sea sand in which the trees commenced to grow. The inverse process is seen where rich forest land is cleared of forest and cultivated in cereals, until after 10 or 20 years it is "worked done." Not only does a timber crop accumulate humus, but it benefits by it meantime, and in more ways than one. The humus itself is a highly fertile soil, in which, without any other ingredients, tree life is strong and vigorous, for since its composition is highly organic, its decay not only yields valuable plant-feeding materials, but continues to receive and fix these from the atmosphere in fit form for use as required. But, besides this, its mechanical condition, which is very open and porous, assists the complete aeration of its particles and interstices; it also assists drainage and prevents saturation; it absorbs a much larger amount of rain without damage to plant life than most other soils, and it continues to absorb moisture without allowing almost any to run off during heavy rains, which, stored in this hygroscopic sponge, can percolate more slowly into the subsoil afterwards instead of going off in floodwaters, and cutting dongas which drain the country down to the rock surface. Humus also acts as a perfect mulch, preventing evaporation, and keeping the subsoil cool. It will be seen therefore that in such a country as this, and especially in the drier parts of it, having comparatively a low rainfall, a high temperature, long-continued seasons of drought, and in many places no rains except very heavy thunder showers which are apt to run off, a heavy mulching with humus must be of enormous advantage to a timber crop, and every endeavour must be made to secure this at as early a stage of the crop as possible.

The amount of humus produced varies exceedingly with different kinds, but in a general way deciduous trees and pines produce much more than others, and as deciduous trees generally thrive best in bottom lands, where humus is less of an absolute necessity, and where also gums, wattles, and other kinds do well, pines remain the most satisfactory kinds for planting on high and dry ridges where the beneficial effect of humus is very evident, as also on all the dry and presently treeless slopes of the higher mountain ranges. On such ground, especially if the aspect happen to be a northern one, the formation of soil and the retention of moisture are of first importance, and can best be produced by having pines closely planted or sown, so that an abundance of fallen leaves may cover the ground at an early date. Close stocking also secures other advantages to which reference may now be made.

Canopy.—Direct sunlight upon the surface of the soil has a very drying effect anywhere, but more especially on such a hot northern exposure as has just been described, consequently any means by which this can be lessened is welcome. In sylviculture the effective means at hand is to so regulate the stock of trees as to secure, as soon as the trees begin to form branches, a complete canopy under these branches, which is thereafter maintained as long as the crop is on the ground. This canopy, which nature always endeavours to produce, can be secured to young crops either by stocking close enough to bring the trees into such contact as completely shadows the ground without the formation of large branches, and prevents such from being formed, or by planting much wider and thereby giving the trees every inducement and opportunity to produce an abundance of large horizontal branches. Consequently if wide-spreading ornamental trees are required, wide-planting must be followed, whereas if unbranched clean timber is desired, the planting must be close enough to secure this.

When complete canopy is secured the number of stomata per acre is about the same in any one kind, whether it be planted closely or widely, and there is consequently about the same amount of carbon fixed, and of timber formed, but with this difference, that if the planting be wide numerous heavy branches will be formed, themselves useless as timber, and causing knots in the main trunk, which render it also useles for timber purposes, whereas if the planting be too close, the wood formation is performed by too many individual stems, many of which, to prevent suffocation, must be removed while too small to be of use. For economic timber production therefore a happy medium is desirable, which is best obtained by stocking so closely as to produce close canopy in three or four years, and by thereafter thinning *often and lightly*, removing sufficient on each occasion to prevent crowding, but not enough to admit direct sunlight, or the formation of heavy branches. The original espacement as well as the subsequent thinnings

must therefore vary in accordance with kind, and also in accordance with soil, aspect, rainfall, and all other affecting factors, and cannot be definitely settled except upon the merits of each individual case.

Canopy has been spoken of as a cure for the drying effect of direct sunlight by reducing the temperature under the trees, and consequently preventing a certain amount of evaporation from the surface of the soil. It must also be borne in mind that at a high temperature the atmosphere carries an amount of moisture in a gaseous form, which at a lower temperature surcharges it, and becomes deposited in the form of mist, dew or rain. The variation in temperature between the atmosphere outside and that below the covering canopy depends during bright weather on the age, depth and density of that canopy, but is often sufficient when the atmosphere is moisture laden to cause an aqueous deposit inside the forest, while outside there is none, and is usually sufficient to cause a moistness to pervade forest shade, and have considerable influence on tree growth, hence the necessity for keeping the outskirts of a forest or plantation dense, and unpruned to an extent sufficient to exclude hot, drying winds.

The effect of the consequently lowered soil temperature is beneficial not only for the same reasons as the lowered atmospheric temperature under canopy, but also in that it causes the trees to start later in spring, and thereby avoid the danger of late frosts, which are often injurious to deciduous trees grown in the open.

The main factors which influence tree life from the start onward are temperature, rainfall, and soil.

"*Temperature*" affects every kind of plant, but in varying degree, consequently in so far as not affected by other causes, each species has a belt in the Northern and another belt in the Southern hemisphere, suitable for its existence and culture. This belt would naturally be of regular outline, comprising one or more parallels of latitude, but since ocean currents, monsoon winds, altitude above the sea level, distance from the sea, and the conformation of surrounding country, all affect its direction, the result is in most cases a very irregularly waved line, sometimes awanting, occasionally appearing only at certain altitudes, and often containing within itself areas which belong to different isothermal belts; and all other factors being suitable, any tree growing on one part of that belt will succeed if naturalised into another part, in either the Northern or Southern hemisphere, and as far outside the belt as the elasticity of the species will allow.

But in any given area of considerable extent increasing elevation above sea level frequently places several isothermal belts one above another, since increasing elevation has the same effect on temperature as higher latitude, as for instance at Kilimanjaro, where all the successive isothermal zones from the

tropics at the base to the snow line at the top may be passed through.

Both altitude and latitude are affected by many outside factors, but in a general way one degree of latitude has about the same effect on the mean temperature as 500 ft. altitude, viz., 1.5 deg. F hr.

The effect produced by actual altitude is however modified very much by comparative altitude; thus one place at an elevation of 3,000 feet placed above most of the surrounding country may have a temperature varying little from the average at any time, and never reaching freezing point, and therefore suitable for many kinds of trees which it is impossible to cultivate at another neighbouring spot at 1,000 ft altitude falling within the same isothermal line, but affected by extremes of heat and cold as such valleys usually are.

"*Rainfall.*" The kinds of trees composing any natural bush are usually found to be arranged in accordance with the amount of moisture which these trees can exhale; that again is dependent on the amount of moisture available (the kinds which require more than is available gradually dying out), so that except where there are perpetual subterranean supplies of water, the character of the natural arboreal vegetation is regulated by rainfall, and in sylviculture the same survival of the fittest takes place, except sufficient care be exercised when planting to use only kinds befitting the rainfall and the soil.

But the actual rainfall as measured hardly indicates every possibility in sylviculture, in so far as an annual rainfall of, say, 30 inches of thunder showers in a dry district is not equal to 30 inches of steady coast rain in another moister one.

Almost everywhere within reasonable elevation and latitude, and where man has not interfered, a high regular rainfall is accompanied by a natural arborescent vegetation, or is capable of producing an artificial forest, while with a very low rainfall, tree vegetation is naturally absent, or so modified in character as to be comparatively useless, and any attempt to carry on sylvicultural operations in such a region requires care and experience.

That a high regular rainfall assists woodland growth is certain; it is also claimed that forest growth tends to increase the humidity in the manner already explained, and thereby produce conditions more suitable for extended sylviculture.

"*Soil and Subsoil*" are most important factors in tree growth. Trees require fewer food elements, and some of them in lesser quantity than other agricultural crops, hence their frequent presence on soil which is unfit for cultivation, and hence also the common practice in Europe of planting trees on soil which it is found unprofitable to cultivate; but it by no means follows that because trees will thus exist they should not be allowed to compete with cereals and other crops, on alluvial soils of greater depth, and more highly charged with fertile organic matter.

Frequently even the decomposing rock strata contain these valuable ingredients where they are in the form of soft shale, sandstone, or limestone, and have at some previous period themselves been in the form of alluvial deposit before petrifaction took place. A very large portion of the surface of South Africa has subsoil of this nature, viz.: stratified rock which on decomposition yields a fairly fertile soil, well suited where deep enough, and where the under-lying rock is soft and natural, for the growth of several kinds of trees, indeed for pines few better soils exist. But South Africa has also at some time been subjected to an enormous amount of subterranean heat and volcanic action, with the result that in many places the stratified rocks over, or under, or in proximity to the then molten matter, have been heated and altered in nature to such an extent as to be impervious to water, impenetrable to tree roots, and very little liable to atmospheric erosion. Where this is the case the impervious subsoil causes saturation during wet times, and is unable to yield sufficient moisture during dry times, and is therefore to be avoided in selecting ground for tree-planting.

Except there be any deleterious constituent present, most trees will thrive on any ordinary soil if given all other suitable conditions, and the selective power of the rootlets already refered to enables most kinds to take what they want from the soil, and reject the rest, though there are well known cases in which a certain kind fails to thrive unless lime or iron be present, and others in which a certain species fails to thrive unless one or other of these be absent.

Such exceptions must be carefully noted in practice, but, beyond them, trees are in general very accommodating in the kind of soil required, provided there be enough of it, and that its texture and mechanical condition be right. Any porous and naturally well drained soil over-lying a subsoil equally porous answers much better than one in which either the soil or subsoil is impermeable or too retentive, such as indurated sandstone, or pot clay. Roots follow moisture, and if the moisture be deep-seated in a porous subsoil, the roots will find their way down to it, and manage to endure long droughts, whereas if an impervious layer be near the surface, the roots are all surface roots, surfeited with sap during wet times, but useless as soon as a prolonged drought sets in. Even deep soil may be reduced in value by the presence of deep drains acting as drains at a depth at which the water should be all stored up. Where artificial irrigation is practised it is often abused by the too frequent application of water which draws the roots to the surface, and leaves them in a helpless condition if at any time the supply of water for irrigation falls short. In all sylvicultural operations on a commercial scale, it is wise to do without irrigation even though a certain number of trees be thereby lost, since the balance are rendered better able to endure further drought.

The extreme drought of winter and the uncertainty of when rain will begin renders the European practice of winter planting with open roots impracticable here. It is found better to have the ground prepared by ploughing and cross-ploughing during the previous season so as to secure a completely rotted turf, and to delay planting until summer rains have actually commenced. This applies to all kinds except deciduous trees, which must be planted during winter even though artificial watering has to be practised. Single trees can of course be easily planted in spring, and kept watered until rain arrives, but for extensive sylvicultural operations this is impracticable, and it is also unnecessary, since the condition of rest produced by winter in Europe can be produced here at any season by cultural operations, while some of the kinds used here may be successfully transplanted at any season without being in a resting condition. To secure this, however, the young trees must be growing in such a manner that they can be transplanted with a good ball of soil undisturbed at the roots, which is most easily obtained by growing the trees in what are known as transplant tins, say 5 inches deep, and with 20 to 30 trees in each tin. If not too old these trees can be cut with a trowel or knife, and planted out without any roots or soil being disturbed. Almost all the evergreen kinds usually grown are amenable to this treatment, and if not too large (say 6 inches) seldom suffer at all from transplanting, even though in active growth, but are better to be hardened more or less by receiving reduced water supply for several weeks previous to planting out.

Some kinds, more particularly pines and cypresses, though quite successful under the above treatment may also be grown, and grown much more cheaply without tins, by sowing in open nursery beds, and then by being frequently transplanted while quite young. The effect of this transplanting is to make the plant less dependent on the tap root (which may with advantage be shortened back) and more dependent on the lateral roots which are then produced in greater abundance, until at the final planting each root has a mass of active young lateral roots, and no heavy tap root. As the success of the operation depends on the plant having been frequently deprived of its larger feeding roots and thereby brought into a hard sturdy condition, and simply kept alive, but not kept growing, by the mass of young rootlets, it follows that the more frequently this operation is practised, the more successful are the results. It will also be seen that under this method a strong vigorous plant in growthy condition has small chance of success as compared to a smaller and more hardened plant. The transplanting does not, however, require to be a complete change of site on every occasion, the same purpose being answered after the first transplanting if the plants are lifted *en masse* with a fork, far enough to break any long roots, and then allowed to settle down again where they were. This process is spoken of in the trade as

"teasing" the plants, and in experienced hands produces an enormous saving of cost without lessening the results.

A further saving of cost may be made with some kinds by sowing *in situ* where the trees are intended to remain. This is the natural, and theoretically the most perfect method of afforesting, especially for a hot, dry country, since thereby the tap root, which usually finds its way deeper than the lateral roots, is undamaged, and may be able to draw moisture after the surface is very dry. This accounts for the natural forests, and even single trees on the veld, being able to stand more severe drought than most planted trees. Consequently where sowing is practicable it is to be recommended, and probably its use will be vastly increased in future. But it also has its disadvantages. Many kinds of seeds are so fine that they require careful nursery treatment to bring them up, and would be entirely lost if left to themselves in the field. Again, for all kinds, unless the ground be quite clean, there is the danger of seedlings being unable to keep ahead of the weeds during the early stages, or requiring much labour to allow them to do so. There is also the fact that a tree dependent on a deep tap root alone, and without lateral branches, has usually less food supply, and consequently slower growth.

Sowing *in situ* is limited therefore to such kinds as wattles, pines and oaks, which, having large seeds and rapid growth, are able to pull through.

It will be noticed that the removal of the tap root is necessary for trees which have to be transplanted, while its retention is the main desideratum with "in situ" sowings which are to remain permanently where sown.

It will also be noticed that the size of the seeds affects sowing, since no kind of seed can be depended on to germinate freely if sown at a greater depth than its own size under the surface.

Thus acorns may be sown an inch deep, while wattles and pines require less than a $\frac{1}{4}$ inch of covering, and gums require to be sown almost on the surface, and in order to avoid drying out are better to be shaded somewhat.

Whether "in situ" sowings or the use of nursery transplants or seedlings be adopted must depend in each case on which can be done the most economically, *i.e.*, at least cost combined with efficiency, and the further question of whether much or little seed per acre is used must depend on whether the cost of seeding heavy enough to ensure good results is less or greater than the cost of a light seeding together with the filling up labour necessary to give a good crop.

To what extent the cultivation of the soil for and among plantation trees should be carried, depends somewhat on local circumstances. As has been already explained, the practical effect of such tillage is by aeration of the soil to induce surface roots and rapid growth. If these can be always maintained,

then the advantage of cultivation is evident, but rapid growth requires large water supply, and where this is likely at times be wanting, it may be better to give only such cultivation from the start as will secure a slow and hardy growth capable of being maintained through the driest times, and to carefully avoid the most moisture-demanding kinds in such places. The only difficulty then is to secure safety from fire. But since land is comparatively cheap it may be questioned whether, except under exceptional circumstances, it is worth while afforesting such places, so long as suitable and sure ground is obtainable, since the cost of special extra labour on such is sometimes greater than the buying price of good ground on which more satisfactory and more early results are assured.

I have mentioned several methods as less expensive than others, and to be a sound financial investment it is necessary that a low initial cost, as well as a comparatively early return, should be secured, since every additional shilling per acre, as well as every additional year in the rotation, has a telling effect when compound interest on the original outlay goes on for say 50 or 100 years.

It is also necessary on this account to use only kinds which will give a comparatively early return unless the slower kinds have a much greater value when mature.

Another point is to have the crop suitable for the market whatever that is, or may be expected to be by the time the crop becomes mature, more particularly if the expected market be a purely local one. The pecuniary returns must form a central point in all calculations connected with sylvicultural work, with the exception of the few cases, such as drift sand reclamation, in which the purpose served is more important than the returns.

It has been noted that each kind of tree, as well as each class of trees, has its individual characteristics and requirements which must be carefully studied. Thus pines as a class yielding much humus, and requiring comparatively little moisture, are particularly adapted for use on hill slopes where few other kinds would survive.

Gums and wattles on the contrary yield little humus, and have heavy moisture requirements, and consequently are better adapted for moist alluvial valleys, such as alone suit oaks, the choice between these three kinds depending on whether an early return of mining timber, or bark and firewood, will pay better than a later return of more valuable oak timber.

Though native of hot and dry Australian regions, and having very different requirements among themselves, the gums and Acacias must be considered harder on the soil than most other kinds, yielding little of the nature of foliage refuse, and making more demands for moisture than their canopy and shade induce, so they require a good deal of subterranean moisture, and probably do not improve a dry soil to anything like the same extent as pines do.

Then again some trees can endure a great deal of cover over them, as for example almost all our indigenous trees, or say Pinus halepensis, while others like *Pinus pinaster* do well as a pure, equal-aged, and equal-sized forest of that one kind, but die out when mixed with other kinds, which overtop and suppress them.

These individual characteristics are too numerous for mention here, and affect more the practice than the principles of sylviculture, as also does much of what has had to be introduced into this paper to make it clear. But in order to make sylviculture successful these individual characteristics, as well as all the principles affecting the subject, require to be taken into consideration together, and from them a working plan of the proposed work fully arranged, which should not afterwards be lightly departed from.

I will therefore close by briefly recapitulating the more important principles, and mentioning such others as have not already been alluded to.

"*Natural factors of tree growth.*"—Trees, like all other organic beings are more or less subject to the action of external influences, which have produced, by gradual evolution, special forms particularly adapted for special conditions. In every case the suitability of the kind to the locality and conditions must be studied before planting.

Temperature places limits on each kind, beyond which it is not successful.

Where there is no underground supply of moisture, drought weeds out such kinds as have requirements in excess of the local annual rainfall.

Trees draw upon the soil and atmosphere for their food. They are more or less affected by the chemical composition of the soil (especially some kinds of trees), but many kinds have, and exercise, much selective power in their feeding, so that the depth and texture of the soil and the nature of the subsoil are in most cases of more importance than the chemical composition.

Impervious subsoil causes surface roots which are unable to maintain growth, or even life, during prolonged drought.

Mountain slopes secure drainage, and South East slopes usually secure more rainfall than other aspects, and being away from the drying effect of the sun, keep it better.

Sylvicultural factors of tree growth."—Deciduous trees must be planted when leafless. Other kinds must either be planted with undisturbed root-balls, or have been previously forced into a dormant condition by cultural treatment.

Trees (especially some kinds) improve and accumulate soil, and leave it in a condition at the end of a rotation for kinds which at the commencement of the rotation it was unsuitable for.

By canopy trees reduce the temperature, and thereby cause a moist atmosphere to deposit moisture, which without the forestal influence is retained in the warmer atmosphere.

Canopy prevents evaporation, and when unpruned and unbroken at the margins prevents the ingress of drying winds.

Cultivation assists rapid growth, and is an advantage at the start, where such growth can afterwards be maintained. Otherwise its value varies with local circumstances.

Irrigation is always subject to abuse, and abundant water supply is usually to be avoided unless it can be maintained throughout, as any temporary check is then more injurious than if growth had been slow and steady.

Light-demanding kinds must have pure forest except they be far ahead of underplanted shade bearers, while shade bearers are usually better of cover at first.

Espacement should be close enough to always secure canopy without crowding, and pruning or thinning must be practised whenever necessary.

Trees with heavy branches are useless for technical purposes, and the production of these must be prevented either by close planting or by pruning.

"*Economic factors in Sylviculture.*"—Including purchase price of land high-priced good soil easily worked is more profitable than low-priced soil, bad, or difficult to work.

"In situ" sowings of the larger seeded kinds are the natural, drought resisting and economic method of afforesting where ground is clean and sufficiently moist. Small seeded kinds require nursery treatment.

Next to sowings "teased" seedlings are to be recommended in experienced hands, and transplants to other planters. In each case trees 6 inches high are preferred to larger for extensive planting, except with regard to deciduous trees.

Where natural regeneration by seed is practicable, as under felled wattles, matured pines, etc., that is the most economic method, and requires only protection against fire.

All sylvicultural labour is lost which does not receive efficient protection from damage by fire and trespass. Against fire a clean belt under non-inflamable trees is most effective.

For convenient working large plantations should have graded roads left not more than 200 yards apart. These if kept thoroughly clean or planted with non-inflammable kinds act also as fire protections.

Except on an experimental scale, only the few kinds of proved value and well recognised qualities should be used.

A small area well stocked is more productive of good material, and pays better than a large area badly stocked, and to be thoroughly successful all filling up should be done during the first year.

Kinds used must suit the market, and except the market be quite local, plantations should be near the railway.

Economic maturity depends on many outside factors and may range from two years old for hut-wattles, to 20, 50, 100, or more years for heavy timber.

To yield a steady annual return, haphazard planting of job lots is thoroughly unsuccesful. The first preliminary is a carefully studied out working plan which must afterwards be rigidly adhered to, unless very special circumstances interfere. This applies to small as well as large plantations.

So far as successful results will allow heavy initial expenditure is to be avoided, since compound interest on this gives a plantation an enormous cost in a long rotation.

Now—Since the natural forests of the Colony are composed of hardwoods, and the import of timber is very largely pine timber or hardwood sleepers, the production of these classes must be enormously increased, and I need only mention that except in the proximity of mines or towns where there are other special demands, those who would profit by sylviculture would do well to make these classes their mainstay, and in the preparation and culture of their trees and land, to rely more on sound common sense in the application of the principles above mentioned than on any formula of so-called necessary routine, which may or may not be successful in accordance with the special circumstances of each case.

CHAPTER VII.

TREE PLANTING IN THE UPPER DISTRICTS OF NATAL.

(Paper read before the Dundee Farmers' Association, September 16th, 1903.)

Any visitor passing through Natal from Durban to Charlestown must be struck by the beauty of the Midland district, diversified as it is by artificial plantations and clumps of natural "bush," as compared with the somewhat bleak and often monotonous and flat, treeless country beyond. If this were a question of esthetics only, and unconnected with the value and productiveness of the respective districts, probably little attention would be paid to it by the inhabitants, but it is now recognised that in some districts there is cash in wattle culture, and that all the timber required in and beyond the bare tract has to come from below, while the absence of shelter is a standing grievance to almost every farmer; consequently, the enquiry what to plant and how to do it is a natural one. Before proceding to answer this, it is well, however, to study briefly the physical geography of Natal in its relation to tree-culture, because this is one of the most important factors in determining the points raised.

The coastward and Midland districts comprise several abrupt changes in altitude, the steep slopes in each case extending more or less parallel with the sea, and facing eastward, or south-eastward, while the plateaux above are level, or rolling, or sloping very gradually. The steep eastern faces are mostly treeclad, or have been so; the vegetation being of the slow-growing, evergreen, indigenous bush nature, which has long ago formed, and still maintains, a spongy hygroscopic leafmould humus, wherein moisture is collected during rain, and given off gradually thereafter. This moist base, together with the dense evergreen canopy overhead, creates a cool moist atmosphere among the trees, into which sun heat, hot air, and forest or grass fires are alike unable to penetrate except little by little along the outer margin. It is well known that the clouds carry more moisture without being saturated, at a high temperature than at a low one; and in consequence of this, when a cloud containing much moisture is driven off the sea and strikes against a cool forest-clad mountain face, it enters there a temperature too low to maintain the moisture contained in the cloud, which moisture thereupon falls as rain

until the equilibrium is established, after which the state of saturation shows itself as mist until the temperature rises sufficiently to again carry the moisture in an invisible form.

The several mist-belts of Natal, whereon through the above cause mist hangs almost continuously during summer, are well known, and in every case connected with a more or less steep slope facing eastward, or south-eastward, and a certain amount of natural forest, or rank grass, which has almost the same effect. The natural forests have consequently a decided effect in precipitating rain, and maintaining a supply of moisture in the soil; rain and constant subsoil moisture have, on the other hand, a strong influence on the production of forest growth. A reciprocity exists between the two, and the influence of each on the other extends for some distance beyond the actual points of contact, making the immediate neighbourhood of such slopes all fit for tree-planting if there be soil enough.

In all parts of the world, and in respect to most species of valuable economic timber trees, the natural home of trees is on steep ground facing the moist winds of the country, and usually not directly facing the sun. The only important exception to this is in respect to such species as naturally inhabit moist alluvial bottom lands. These facts have to be carefully considered in connection with the afforestation of the upper districts of Natal, for above Mooi River there are practically no treeclad slopes, and few slopes naturally adapted for being tree-clad, until the neighbourhood of the Drakensberg is reached; though there again, along the whole length of the range, the cooling effect of the mountain mass precipitates rain or forms mist to such an extent that forest clumps occur naturally.

Now, where indigenous trees thrive naturally there is usually almost no difficulty in securing an abundant and healthy growth of many kinds of exotic trees; indeed, so much is this the case than an erroneous impression has become prevalent that trees of *all* kinds and from *every* climate will thrive *if given sufficient attention.*

But it is when one comes to deal with the more level, more arid, and naturally treeless districts that much more difficulty is experienced, more careful selection of kinds is necessary, and in not a few instances different treatment is required. In this paper these treeless districts are spoken of as the "Upland Flats," while the steep slopes beyond are referred to as the "berg" and its vicinity. The different localities in Natal cannot well be grouped together in any advice given as to kinds, because the climates and conditions vary so much, and each kind has some special requirement of its own. But in some things the suitable kinds have requirements in common. Thus, in particular, most parts of Natal have a dry winter and a comparatively dry spring, while the rainfall is mostly a summer one, though varying alike in quantity and in nature in

different localities. In other particulars, as for instance in the degree of cold a species can stand, certain species have their area sharply curtailed by being too tender for frosty districts, while others show a considerable laxity in this respect; and a species may, by propagating only its hardier forms, become acclimatised in time; again a moisture-loving species may, by gradually reducing its moisture through successive generations, evolve a form less dependent on moisture; but in respect to the season of rainfall, acclimatization means a wholesale reconstruction of the nature of the tree, and is consequently more difficult to accomplish, and the less frequently accomplished. Thus, such evergreen trees as are accustomed to make an uninterrupted growth, through having sufficient moisture all the year round, naturally resent a period of drought, whether in summer or in winter. Again, trees used to winter and spring rains and hot dry summers, such as those of West Australia, suffer when the seasons are reversed, as happens here, and we have instances in Eucalyptus calophylla and E. marginata (Jarrah) of trees which seldom do well here, and which, from a study of season conditions, one would be surprised to find doing well: while Pinus insignis, accustomed to winter rainfall, gets its active growth here just as the dry winter sets in, and soon exhausts the available moisture and dies back, from the top downward, until the whole tree is dead. It is then of the utmost importance, in selecting kinds, to select them from a similar general climate as that in which they are to be planted, keeping in mind, however, all known facts regarding the elasticity of character of any particular species, through which that species may be induced to flourish in what would at first sight appear an unsuitable situation.

Altitude is often regarded as a determining factor as to whether a site is or is not suitable for a species, but, taken alone, altitude is altogether unreliable in this respect. The presence and severity of frost regulate tree growth much more than actual altitude, and these do not, as is sometimes supposed, act together. It is true that there is a slight fall in the average temperature for any considerable rise in altitude, but at the same time low flats, especially if marshy, are subject to severe radiation frosts which hillsides and even mountain-tops are often clear of; consequently, in giving advice from a distance as to what trees will succeed in any locality, general principles can only be used in the widest sense, and the planter has, after all, to exert his own common sense in making use of all local factors which an outside expert may know nothing about. It is the relative position with regard to all surrounding objects, rather than the actual latitude, which requires study. For instance many trees are quite healthy at Johannesburg which are killed out by frost in the upper districts of Natal at much less altitude.

But again, allowing rainfall and temperature to be right, it is necessary that soil conditions should also be favourable. Timber trees never are satisfactory on light, shallow soil overlying shale; and very seldom are they satisfactory above any flat and solid rock. On steep hillsides, however, especially if the subsoil is composed of broken rock debris, and the aspect is away from direct sunshine, tree roots wander freely and enjoy the moisture and coolness which is ever-present in such a locality, giving in return an abundant and healthy growth, suitable for the highest economic purposes. Trees are less particular concerning soil than are most agricultural crops, hence arises the idea that whatever ground is not good enough for crops is fit for trees, but at the same time trees demand and are particular about receiving a mechanical condition of the soil which keeps them constantly moist without ever being saturated, and where this condition is absent, tree culture is usually disappointing. Thus the soil on which Black wattles thrive most luxuriantly is a deep chocolate sandy loam, so destitute of available crop-food that mealies and even oats will hardly live on it without phosphatic manure, but the mechanical condition is right for trees, while on the other hand, rich bottom lands which carry successive grain crops without trouble are often unable to carry a timber crop through a dry spell. So also the poor sandy moorland, where sugar-bush grows naturally, is usually better suited for a crop of pine trees than the richer alluvial formed by its washed out finer particles, and it is often noticeable that trees do better on igneous kopjes, where the stones are placed as loose boulders, than they do on level land, where the rocks do not show on the surface but are present and solid underneath. Putting all these factors together, the number of available trees is considerably reduced, but it is much more so if growing timber for profit is the object. This is because from among the many kinds which *can* be grown, only a comparative few possess the other qualities necessary to yield a profit, though quite fit for growth for ornamental purposes; and it therefore becomes necessary to distinguish between the different classes of timber, while even in any one class the proximity to, or distance from market, decides whether or not it is possible to grow that kind and class with profit.

The principal classes, in addition to indigenous timber, are (1) soft-woods, (2) cedar-woods, (3) durable hard-woods, and (4) non-durable hardwoods.

Meantime Natal-grown timber is hardly on the market, not because it does not exist, for much is gradually going to waste in the natural forests, but because the labour and land transport from the forests of Natal cost as much as the labour and sea transport from the Baltic or North America; while on account of the huge quantities passing through hand a more finished article can be turned out at these latter places than the machinery in use here can undertake. And so it must

remain until the railways touch the few natural forests, until timber scarcity all the world over begins to be felt, and until the conversion of Natal timber into cash becomes an industry, instead of the occasional by-occupation of kurveyors when not otherwise engaged. But the total extent of the natural forests is altogether insignificant in view of the requirements of the Colony and of the hinterland, while supplies in other countries are rapidly going done. It is then of the utmost importance to proceed with the formation of plantations, not only as shelter-belts and for picturesque effect, but also on an extensive commercial scale, and of such kinds as are sure to command a market when they are mature.

For this purpose suitable sloping land, on or near the Berg, and especially if facing southward, is of much greater value than the upland flats, even though it costs more to work. In such berg situations the number of kinds found suitable is very large, as the cool climate, the frequent showers which fall occasionally in winter as well as in summer, and the rising ground providing drainage and shelter, are all favourable factors.

Taking the groups separately, the following remarks may be made:—

(1.) Soft-woods.—These include the pine timbers meantime forming nine-tenths of our timber imports, and used raw for all household and general purposes, and creosoted as railway sleepers. Pines do well along the berg, and though they cannot compete in volume of timber with some of the gums, still they rapidly run into timber. It is unfortunate that the best known and most largely planted pine, Pinus insignis (Fig. 77) is one more or less unsuited to the climatic conditions of the country. Its natural home is a very small area on the North Californian coast, where winter rains allow it to grow more or less uninterruptedly all the year round, while here the dry winter and spring, coming on just while its second growth is being made, cause a failure of the young sappy tips, often followed by a gradual dying back for years, ending in death. This is the more to be regretted, because P. insignis produces more timber per acre during its period of health than almost any other tree; and, contrary to the general opinion, its timber, when kept clear of knots by close planting, is of considerable economic value. Always an ornamental tree when healthy, there are many Berg situations in which it continues healthy till it reaches a good timber size; and while it cannot be recommended for use everywhere, and must only be planted in spots selected with due caution, this species is often unjustly condemned in too sweeping terms. But planters cannot be too often reminded that other and more durable kinds are not to be condemned, as is so frequently done, because their rate of growth is not equal to P. insignis or Bluegum, these two having been accepted as popular standards of desirable growth, while these two trees themselves, when

grown are not considered satisfactory. Something less rapid but more sure will have to be adopted as the desirable standard in future, alike in pines and in gums. Throughout Cape Colony, Pinus pinaster (Fig. 75) is being planted more largely than all other trees together, and though its culture in Natal is limited, there are enough evidences to show that it is safe to plant on the mountains and on the mist-belts, as the main future supply of soft-wood.

P. halepensis (Fig. 34) lives in even drier and more bleak climates, and is also able to endure more rocky soil than P. pinaster, but is slower in growth, and seldom grows so large; while P. canariensis (Fig. 41) has in many places shown itself a good competitor to these, though in Dundee and elsewhere in that District, nearly half the trees planted of this kind resulted in distorted failures, probably from being too far from the coast, its natural home being on the islands of north-east Africa. But, if their natural climatic conditions are considered, P. longifolia, the Chere Pine of the Himalayas, ought to be even more at home than either of these, though, thus far, few if any trees of this species are in evidence. In certain stages of growth it is difficult to distinguish from P. canariensis, and in others it closely resembles P. australis (Fig. 43) from the south-eastern United States, another pine which promises well indeed here, though its natural climatic conditions are hardly met. P. excelsa, on the other hand, comes from higher elevations on the Himalayas; it is used to winter snows there, and is altogether unreliable in its behaviour here.

(2.) Cedar-Woods.—This class includes many coniferous timbers more or less resembling Cedar-wood, in addition to several non-coniferous timbers, such as Teak, Toon, etc., in which the appearance of the timber supersedes the want of botanical relationship. They are usually of higher quality and durability than the soft-woods; often more expensive, more valuable, and of slower growth. Cedrus deodara (Fig. 35) is one of the valuable Indian timbers, and one which in Natal gives perfectly satisfactory growth from Inchanga to the top of the Drakensberg, though it does not do well at or near the coast.

Cryptomeria Japonica (Fig. 75), which is the most useful timber tree of Japan, does equally well wherever there is a fair rainfall, though it suffers somewhat during the dry winter in the more open situations, and in some places requires irrigation during winter.

Cupressus has many species, all valuable timbers when properly grown, and mostly fit for growing toward the berg, and on deep alluvial elsewhere.

C. pendula-glauca is distinctly the most successful in the upper districts, and C. macrocarpa, (Fig. 40) though it flourishes at first, is the most unsatisfactory after a time, a result almost to be expected from the climatic conditions of its natural habitat. Taxodium distichum (Fig. 40) and Sequoia sem-

pervirens are less common but equally useful trees; both thrive in cool mountain ravines, and prefer deep soil and reasonable moisture. Juniperus virginiana, (Fig. 30) the red pencil cedar, though rather slow, is one of the most enduring trees of this class, and is not damaged by either cold or heat, or by rocky or clay subsoil, but it is not suitable for brack ground. Cedrela (Fig. 49) and other broad-leaved trees of this group belong to the coast and sub-tropical or tropical conditions, and are unsuited for upland culture, but Causarinas, which vary in quality in accordance with species, are worth attention, especially C. leptoclada (Fig. 29), the most rapid-growing and most useful white timber of the genus.

(3.) Durable Hardwoods.—This is perhaps the most important group we have to deal with, inasmuch as it includes a large number of species of most useful timbers, mostly Eucalypts, and in not a few instances well adapted for growth either on or away from the mountains. Among the more hardy of these may be mentioned Eucalyptus paniculata, E. siderophloia, E. sideroxylon, E. rostrata, E. tereticornis, E. saligna, E. punctata, E. hemiphloia, E. leucoxylon, E. goniocalyx, E. microcorys, E. corynocalyx, E. odorata, etc., while more tender, but otherwise equally valuable species which only do well on the mist-belts or coastward are E. crebra, E. corymbosa, E. maculata, E. pilularis, E. citriodora, and E. diversicolor, concerning which latter species doubts have been cast on its durability. The most durable Australian gum, the Jarrah, E. marginata, is climatically unfit for use here, and in practice has proved a failure.

(4.) Non-Durable Hard-woods, or rather hard-woods which are usually non-durable in the ground, and which consequently lose much of their value as compared with the previous list. Among these may be mentioned E. macrorhyncha, E. capitellata, E. obliqua, E. coriacea, E. Gunnii, E. viminalis, E. stuartiana, E. amygdalina, and E. globulus. These kinds are easily grown, and grow into timber more rapidly than the pines. Their value, however, can only be considered equal to pine, since their use is for in-door work only, and even for that they are heavier, more costly to transport, more difficult to work, and less open to receive creosote than the ordinary classes of pine timber. In addition to this, they have all more or less a reputation for durability, which, under certain conditions of growth and of treatment as timber, is occasionally borne out, but is more apt, in the ordinary course, to lead the timber to be used for purposes for which it is unsuited, and eventually to bring about disappointment. While there is no reason whatever why these kinds should not be grown freely for shelter and for ornamental purposes, especially in high and exposed districts where fewer good kinds are hardy, it is well to avoid their culture for timber, except some special demand for which they are suitable is in view.

It will be noted that the list of trees recommended above does not include any of the kinds in general use in North Europe, the conditions of growth being so dissimilar that they cannot, in ordinary practice, be considered satisfactory. This does not, however, prevent them from coming in as useful trees in certain situations, which must in every case be either carefully thought out beforehand, or else be found by pure chance. For instance, the Oak in fairly cool situations and on deep alluvial soil is sometimes satisfactory indeed; Poplars and Willows along streams usually do well, and are not without economic value; the Cork Oak, the Plane, and the Sycamore are often passable, while the Ash and the Olive have always a tendency to become bark-bound. Spanish Chestnut does fairly well where there is lime in the soil; Birch occasionally makes very satisfactory growth; and Hawthorn is occasionally happy, though more often troubled by insect pests.

But the Beech, the Lime, the Horse-chestnut, and the Spruce are failures everywhere; of the Larch I only know of two satisfactory trees in Cape Colony and none in Natal, and of the Holly, which might be expected to thrive in the higher kloofs of the Drakensberg, Maritzburg shows the best examples.

The common trees of Eastern North America are also to be noted by their absence, the Elms, Oaks, Robina, Gleditschia, Catalpa, Maples, Ash, etc., being all represented by a few specimens which do not suggest further culture, while their class of timber belongs to what we can more easily obtain, so far as wanted, from other kinds. The Tulip-tree (Liriodendron, Fig. 79), is perhaps the most successful of this group, and even that requires deep soil and constant moisture.

It is from South-eastern Australia particularly that we have been successful in our importations of hard-woods, which, besides Eucalypts, include Tristania, Syncarpia, Grevillea, etc., while our successful conifers come from South Europe, North Africa, Eastern Himalayas, China, Japan, South California, and East Australia. Further experiments may yet show that Mexico, Texas, and Peru contain kinds better worth acclimatization here than elsewhere.

Thus far I have referred more particularly to kinds suitable for growing for timber purposes along the berg; and almost all these may be grown for ornament or shelter down even in the flats, though their chances of growing into valuable timber there is, in most species, very much reduced. Indeed only a few species can be depended on to produce good clean timber in such a site, and even then they require really good land, which most farmers are unwilling to spare for that purpose.

Eucalyptus rostrata and E. tereticornis are safe on most alluvial flats, and the other durable hard-woods already mentioned are worth culture on similar ground if not too frosty for them. E. sideroxylon, E. paniculata, and E. hemiphloia do well on stoney kopjes if not too solid inside, and indeed seem

to prefer such a site. Of the Cedar-woods, Cedrus deodara, Cupressus pendula-glauca, and Cryptomeria Japonica withstand the climate and do reasonably well on flat alluvial; while of the Pines, P. pinaster is, next to P. insignis, the most rapid grower, and P. halepensis is the more sure to keep alive.

Of the non-durable hard-woods, all except the Blue gum are as hardy as, or more hardy than, the more durable kinds, and on frosty flats or builts it is sometimes necessary to resort to them for shelter and for ornament; while for temporary props, fuel, and such other purposes, they are often useful. But it must be distinctly understood that on flats, where the soil is shallow and overlying flat rock, the chances of successful tree-culture of any kind are very remote, while in what is known as the Thorn country much more careful selection of soil is required than elsewhere.

Thus far I have made no mention of the Acacias, since they constitute a group by themselves. A. melanoxylon, the Blackwood, (Fig. 70) is one of the most valuable timbers we have, one which can replace or supersede walnut for many purposes, and one which, if well grown, will always command a European market if not saleable here. But as to A. mollissima, the common Blackwattle, that species can hardly be said to belong to the upper districts. True it lives, and sometimes makes fair growth, especially towards the berg, but its natural habitat is within the mist-belt, where it flourishes upon a variety of soils if only the mechanical condition is right, while throughout the upland flats the most frequent mechanical condition is one not suited to the requirements of this tree, either through the soil being too much of the nature of stiff clay, or through its overlying a rock too solid for the Blackwattle to draw its necessary moisture from. In addition to this the Blackwattle is liable to injury by severe frost, especially when it is young; the Silverwattle (Acacia dealbata), being more hardy in this respect, is often useful for shelter and props, where the Blackwattle will not endure. Blackwattle is naturally a short-lived tree, and more so when grown out of its natural conditions, but in many places it is useful for shelter and for ornament, and even for props, where its culture for bark-production could not be recommended. There are several varieties, one of which is said to be more hardy against frost than the others, and it is therefore preferred for up-country sowing.

It is occasionally urged, on sentimental grounds, that indigenous trees should be used more largely than they are in plantation work, but except in the most favoured localities the growth is usually so slow and unsatisfactory as to prevent their being raised in quantity for commercial purposes. That, however, is quite distinct from the protection of forest land in which seedling trees are willing to assert themselves if given a chance;

in such a case the indigenous seedlings often make surprising growth, and well repay the cost of fencing and protection.

An important point in selecting the site for a plantation is to save it so far as possible from heavy hail-storms, for the effect of those, especially on coniferous kinds, is most disastrous.

Taking the subject of tree-planting as a whole, it is impossible to give general directions which will apply everywhere; each case has to be thought out on its own merits, and no statement of latitude, soil, winds, rainfall, physical geography, or even climate can be satisfactorily used alone, apart from the general surroundings, which include, besides all these, the ability of the grower to cope with all unforeseen difficulties, his intention in forming the plantation, and the probable demand or market for the produce when ready. But if shelter and ornament are the only intentions, very many kinds can be introduced so as to give variety and scenic effect, which for timber purposes are almost useless. And, for the former purposes, especially where only a limited number of trees are wanted to relive the monotony of a treeless plain, occasional irrigation may sometimes be practised with good effect, though in the economic production of timber the cost of irrigation, even where small, is usually prohibitive.

CHAPTER VIII.

TREE-PLANTING IN THE MIDLANDS OF NATAL.

(Paper read before the Nottingham Road Farmers' Association, October 10th, 1903.)

In tree-planting, as in many other industries, Nature affords object-lessons which should not be ignored. Where timber-trees grow naturally, these and other kinds of timber-trees may be expected to succeed if introduced artificially, while in treeless country some reason must exist which will probably militate against artificial afforestation as it evidently has against natural growth. Throughout the Midlands of Natal trees exist in forest patches wherever there are steep slopes facing eastward or south-eastward, and there are abundant evidences that at some earlier period these patches had been more connected than they are meantime. Looking broadly at the map of South Africa it will be seen that a belt of forest country extends in a more or less continuous line of forest patches along the whole of the east coast, but at varying, and sometimes considerable, distances from it. Beginning in the remnant of former forests at Swellendam, this belt traverses the Knysna and Zizikama forests, the excessively dry Addow Bush, the Katberg and Amatola Forests, and the Transkeian Zuurberg; then enters Natal at the Ingeli and also in Polela District, passing through Bulwer, Boston, Fort Nottingham, and Karkloof, and extending from these places eastward as far as Ixopo, Richmond, Pietermaritzburg and Noodsberg; then through Zululand by way of Qudeni, Tatabuleni, Nkandhla, Entumeni, Eshowe, Ngoya, and Pongola, while a more inland branch of the same belt passes Melmoth and Ingwavuma into Swaziland.

In all these places steep eastern slopes arrest and precipitate the rain passing in clouds inland from the coast, and produce a sufficiently moist atmosphere to meet the requirements of such timber-trees as enjoy the prevailing temperature. Trees there grow to perfection, dense though comparatively small forests occur composed of grand old specimens in close juxtaposition, clean timber stems devoid of branches are the rule rather than the exception, and every indication goes to prove that climatic and geographical conditions are suitable for the vegetation with which the slopes are clothed.

Beyond the higher ridges of this forest belt, the country, the atmosphere, and the clouds are all more dry, and rain is

less frequent and more violent, and forests almost absent until the Berg is reached, where conditions more like those of the forest belt are again met, but not quite so favourable; consequently Berg forests are more confined to ravines, and even in these they are composed of more stunted trees of smaller diameter, and of less economic value, besides often being twisted and gnarled. In the other direction forests closer to the sea than the recognised forest belt are usually composed in great measure of sub-tropical species of low economic value, of small size, and of bad form, intermixed with only a few really valuable trees; and even in artificial afforestation coast influences do not have the same beneficial effect as midlands mists and rains. Following Nature, therefore, we have every reason to expect that the forest-belt, as above described, will be the most satisfactory site for timber culture, as it has proved the most suitable home for the natural forests of economic importance. And in this, experience bears us out. Although there are many tropical trees which succeed only on the coast belt, and a few mountain species which prefer high altitudes, low temperatures, and occasional snows, still the vast majority of trees suitable for culture in Natal either for timber production or for ornament are thoroughly at home in the forest belt, while more or less out of it elsewhere. But even within the forest belt there are variations of climatic conditions which materially affect tree culture. As already indicated, the steep south-eastern slopes are advantageously placed for intercepting rain-clouds, and either precipitating rain or forming mist; and it is in consequence of this that these slopes are generally known as mist belts; while they are also safe from direct insolation and from hot north winds, and in consequence of the usual dense evergreen forest cover they remain moist and cool, and comparatively free from damage by grass fires or forest conflagrations.

Such slopes, unless composed of solid rock, if not meantime forest clad, have mostly been so before man, with his axe and cattle trespass, removed the canopy, and rendered a forest holocaust possible; in any case such slopes are the most suitable sites for tree-planting, even although on account of steepness and rank grass they cost more to afforest than more open and level sites do. Of the kinds mentioned in the previous chapter as suitable for the Upper Districts, almost all are even more suitable for these Midland slopes, while the more tender kinds then mentioned, as well as many other tender or less familiar kinds, and a considerable number of broad-leaved European and North American species can all be relied upon to give satisfactory growth. For decorative and shelter purposes, therefore, as well as for broad landscape effect, these slopes enjoy the most favoured position, and produce the greatest variety of shades and forms; while for timber production, they are clear of the adverse influences present to some extent almost everywhere else in South Africa, and they are, consequently, the centre of hope if Natal is ever to grow its own timber supply,

or that required in the Transvaal. The indigenous forests seldom occur except upon these slopes, or in deep ravines where similar conditions prevail, but the indigenous forests are mostly composed of last survivors of that forest flora which must have been more vigorous and wide-spread centuries ago, when general conditions were moister than they are to-day; and these last survivors have a constantly increasing tendency to shrink more and more into the most suitable recesses as the general desiccation, which is surely if slowly increasing all over South Africa, becomes more and more pronounced. But among the exotics now being used, there are many which come from places where the climatic conditions are already more severe than those met with here in the mist belts. And consequently they assume an aggresive attitude, and would sooner or later take possession if grass fires could be excluded. It is upon such species as these that we must rely when making an endeavour to afforest slopes facing the sun, or more level land outside the moist belts, whatever the aspect. The area of a mist belt is usually confined to the steep slopes, while the adjacent area over the ridge and facing northward more or less, and sloping down gradually to the next river-bed, is usually outside its influence, and considerably different alike in climate, soil, vegetation and insolation. In such a position as the latter it is not advisable to commence tree-culture on a commercial scale except the soil is deep and open, although for ornament and shelter many species will give good effect, while a few kinds actually improve the condition of the soil. Where there is plenty of depth, the number of kinds that can be grown is nearly as large as that suitable for the eastern slopes, those which have dropped out being mostly broad-leaved deciduous trees which cannot stand bright sunshine or an arid atmosphere, including such kinds as the Plane, the Sycamore, the Elm and the Ash. Eucalypts and Acacias do well, though both these generally transpire very freely, and consequently demand more moisture than their open canopy precipitates except in the moistest nooks, but this excessive demand, which at first is easily met, gradually tells on the neighbourhood, and eventually dries it out, leaving the trees bark-bound, stag-headed, and often prematurely mature. With pines and other slow-growing humus-producing kinds there is, on the contrary, a tendency to percipitate rain and augment the moisture-retaining power of the soil, though with Pinus insignis the growth is rapid and the moisture demand excessive, and often too much for a dry winter, even though the formation of humus is also very large. It will be seen from this that the statement so much used by advocates of extensive tree-planting, that forests produce and store rain, cannot always be taken as an invariable axiom. In Europe, where scientific forestry is mostly practised, the kinds used, and climatic conditions experienced, render this statement usually correct; in most other parts of the world forests in existence are in greater

part natural, and through natural selection of sites and kinds, productive of the same result; but here the demand for early returns, from sites not in accordance with nature, produces the contrary effect. Excessive transpiration is encouraged from positions in which the natural supply of moisture is small and intermittent. The amount of humus produced by Gums and Wattles (Eucalypts and Acacias), is small and too dry to be effective, and there is consequently a tendency produced rather to dry out than to augment the stores of moisture. This tendency has been successfully utilised in many places and in most malarial countries, by the introduction of Blue Gum (Eucalpytus globulus), in order to drain out, by excessive transpiration, what were formerly malarial swamps. The same tendency forms part of the nature of most of the species of Eucalyptus and Acacia which are so largely used in the afforestation work in this Colony, and consequently in sites facing the sun and exposed to insolation, hot winds, and dry atmosphere, the growth of these trees is often found to be more rapid than elsewhere, while it lasts, but more liable to be seriously affected by an unusually dry season, or a few of these in succession. The moral is, for such kinds, give preference to eastern slopes if available, and if these are not available, then select deep soil or open sub-soil if these can be had, or alluvial bottom-land into which the neighbourhood drains itself. But for ornamental and shelter purposes there is no reason why the selection should be confined to Gums and Wattles. These have had preference mostly through being easily raised, and of rapid growth. The Wattles have had further preference through, in most midland districts, yielding an early and sure return in bark as well as timber, and also giving shelter-belts more rapidly and at less cost than any other kind, but on unsuitable ground and aspect they are often unsuccessful where other kinds would do well. Perhaps the most satisfactory tree for shallow soil is Juniperus Virginiana, the Pencil Cedar (Fig. 30), which, though it does not grow rapidly, seldom dies, and under any reasonable conditions does well. This tree is reproducing itself freely on Mr. Topham's estate at Umsindusi, on dry shallow shale; and, though seldom a large tree, it can be relied on where hardly any other kind will live. Pinus halepensis (Fig. 34) is another species of almost equal endurance, but has the further advantage of growing into a large useful timber tree if it happens to get a suitable site.

Cupressus pendula-glauca (Fig. 32 (4) is another most useful tree for ornamental or shelter belts, even on rather shallow soil, though it does best and produces fine timber trunks on deep alluvial soil. It is always a graceful spreading tree, well supplied with branches to the base, and if it has a fault it is that these branches interfere with its timber value, so that special precautions have to be taken against them if the timber is to be utilised.

Cedrus deodara (Fig. 35) (1) is also a native of rather dry ridges, and does very well with light rainfall, though, like most other trees, it makes more rapid growth on slopes containing constant moisture.

In Europe the different Pines are regarded as the best producers of humus, and conseqently the greatest soil-improvers of all forest trees, and though in different species, the same holds good here. The species which produces humus in largest quantity in its earlier years is P. insignis already refered to (Fig. 77). But after ten or more year' growth P. pinaster, Cluster Pine (Fig. 29 (4) is frequently as productive of humus, and being planted at less cost, and also more enduring as a tree, it is preferred for the production of timber, and is planted more in Cape Colony than all other trees put together. The effect of trees towards soil improvement is produced through the actual addition on the surface of layers of fallen leaves or needles, which on decomposition form humus and add depth to a shallow soil, vegetable mould to a sandy soil, and openness to a clay soil. This effect is much more rapid than is usually believed, and it is more easily seen where a plantation is formed on drifting sand, in which case not only is the sand fixed, but a layer of black soil of considerable depth is deposited above the sand within a few years. But the more important effect of humus lies in its relation to the storage of moisture. Heavy rain falling either on dry soil or on saturated soil, especially if on a steep slope, runs off very rapidly, and little is left to soak in. But where there is a coating of humus, which is naturally of an open porous nature, and capable of absorbing a vast amount of water, none runs off; all is retained in the humus long enough to allow it to soak into the soil or subsoil below, and in this way the underground supplies which feed the springs are charged. This water supply, however large or small, oozes slowly and gradually, but regularly, into the springs, which then become constant and of unvarying quantity, instead of a heavy flow after rain and none during drought, as so often happens when there is no humus. A mistake is often made, however, in planting trees around the eye of a spring and along the course of a stream under the impression that these trees will produce this effect. The fact is, springs are seldom fed from their immediate neighbourhood, the flow usually coming from some catchment area at a considerable distance, and usually higher up the same valley. In such case it is not round the eye of the spring, but throughout its catchment area, if such can be discovered, that tree-planting should be done to be effective. And even there the kinds used must be humus-producing kinds, such as pines or broad-leaved deciduous trees, for Wattles and Eucalypts introduced into such a position produce little humus, and consequently form dry forests, while their own powers of transpiration are sufficient to drink up whatever rain sinks into the ground. It is on purpose to afforest the unknown catchment

areas of valley springs that tree-planting is usually carried far up the mountain slopes, wherever systematic and scientific forestry is being carried on. Planting round the eye seldom affects this materially, but it does have an effect in preventing evaporation from the stream as it flows, and this effect continues so far as the stream is flowing in the shade of trees. In India, where the evaporation is very great, it is a crime to cut trees along the course of a stream, or at its head, and I have heard many statements and complaints concerning the drying up of streams in the Natal coast belt since the clearance of bush from streams and springs and from their catchment areas has taken place on purpose to make way for badly kept coolie fruit gardens.

The Natal timber forests of the future, as already indicated, must be produced mostly in the midlands on account of climatic conditions, though it is also necessary, for economic reasons, that they be produced in the midlands or upper districts in so far as the Transvaal is regarded as the market, since the railage from Delagoa Bay limits the distance from market at which material can be laid down at an equal price to the landing price there, and every mile further coastward is that much handicap on the Natal product.

These timber forests are, however, likely to be confined to a comparatively small number of species, not because other kinds have no commercial value, but rather because the demand exists in only a few leading lines for stock in quantity, while other lines in which only a limited stock is wanted are more likely to continue to be imported than to receive supply from local material which has still alike to be grown and to prove its commercial value when locally grown.

The leading lines which may be expected to be grown in quantity are:—(1) Black Wattle, Acacia mollissima (Figs. 56 and 57) in which the bark forms the whole product if grown a few miles away from the railway, though when not too distant the timber has also a nearly equal value for mining props, general purposes and fuel, and may yet take a more prominent place as sawn material than it has yet done. The bark will, without doubt, remain in permanent demand.

(2) Pine timber, the product of various species but more particularly of P. pinaster, P. halepensis, P. canariensis, P. longifolia, and P. insignis. The market for this is as a substitute for the enormous quantities of pine timber meantime imported through Durban and Delagoa Bay for use either in Natal, the Transvaal or Orange River Colony, alike in house-building, mining timber, railway sleepers, (creosoted), or general purposes. This is a demand which exists in all timber-importing countries; it is one which will continue to exist as long as timber holds its present place in the commercial world, and the supply from abroad is rapidly being worked done. To be successful in creating a market for locally grown pine tim-

ber the first few local plantations of this class must extend to several thousand acres each, and thereby come into equal competition with the import trade, not only in small sample lots but in quantities of sufficient importance, quality and finish, to demand attention and sell against the foreign product.

(3) Durable hardwoods, more particularly those suitable for sleepers, harbour works, and ant-proof under-framing for buildings. Suitable species are mentioned in last chapter, all those which are fit for the upper districts being also available and suitable for the midlands, as well as several rather more tender kinds which do best in the midlands and extend rather coastward than up-country.

Non-durable hardwoods can also be produced at a low cost, fit for use as boards and beams under cover, and other similar purposes, but where durable kinds can be grown there does not seem a sufficient excuse for cultivating a second-grade industry except in so far as our information is admittedly incomplete and may remain so until local experiments have reached maturity and shown what class of timber certain species will produce here, not only in one class of climatic and soil conditions, but in every class to which they can be subjected; and these results may only be attained in a hundred years or thereby.

Other kinds of trees suitable for timber production have been mentioned in a previous paper, but the use of trees for ornament requires separate treatment. All the useful kinds for timber production may be utilized also for landscape effect, but not *vice versa*, as many ornamental kinds have no economic value. It is seldom worth while trying to combine timber production with scenic effect, except in as far as ornamental trees may eventually be used for firewood or for general farm purposes. The Black Wattle (Acacia mollissima), is, perhaps, the best known exception to this, for even in its scattered condition as a breakwind or shelter belt it is always ornamental, and lends a charm to the districts in which it is successful, while its bark is not inferior to that produced in the more stiff and formal plantations where dividends are the first object. Indeed, as scattered trees, it assumes a dwarfer and more branching form, (Fig. 56) and a much more ornamental character than it ever does in the close plantation (Fig. 57). The same remark applies more or less to trees of every species, for in ornamental work the first desideratum is a tree clothed to the base with branches, while in timber production branches are carefully prevented, since they produce knots, and consequently reduce the value of the timber. It is because British plantations are all intended either for ornament or for game protection, and treated so as to produce branches instead of clean stems, that British-grown timber is now refused in Britain for all technical purposes, and foreign timber has to take its place. And in Natal there is a tendency to plant trees for

ornament and expect them to prove of economic value, though the two things are naturally antagonistic. Timber production is a stern necessity which sooner or later will force itself upon every South African Colony, but meantime, planting for effect is the more common of the two, and will remain so while trees are planted by the hundred instead of by the millions.

The most noticeable feature in the tree planting of Natal is its rigid and homogeneous character. It consists of either Wattles (Acacias) or Gums (Eucalypts). Wattles in long straight belts with parallel sides and regular angles, and all of one colour, size and form, are more formal and severe than picturesque, though even these are much better than no trees at all, and they have the advantage of bringing in a return both in bark and firewood. Eucalypts of one or even of several kinds, all in straight line and all branchless below and pointed upward above convey a sense of monotonous rigidity which could hardly be associated with a pleasant effect. Almost everywhere the vastness of the scene as a whole, and its absence of variety, render effective landscape planting a difficult matter; but even these difficulties can be got over in part by planting all the higher ridges, giving an irregular outline, using many kinds artistically mixed, and within the planted boundary having clumps or single trees of divers habit and colour scattered about. The tall pyramidal form of a young Blue Gum (Fig. 72) or of a Lombardy Poplar (Fig. 32) is not harsh and formal when appropriately set off by other dwarfer and more spreading kinds, and even an Araucaria (Fig 74) has its formal beauty enhanced by an informal and varied setting. Irregular planting, that is, not only mixing kinds but planting the trees at irregular distances apart, tends to remove stiffness, and if each tree has sufficient room to produce all its branches and keep them till it is mature, a natural and park-like effect is produced which no close planting can show. If, in addition to this, trees of widely varying hues of colour can be introduced, the effect will be much improved. Thus Silver Wattle (Acacia dealbata), Cedrus deodara (Fig. 35) and Cupressus pendula glauca (Fig. 32) can all be used for various glaucous-greens, as also can Eucalypts stuartiana and Blue Gum (E. globulus), while young Blackwood (Acacia melanoxylon (Fig. 70), Black Wattle (A. mollissima (Fig. 56), Yellow-wood (Podocarpus (Fig. 94), and a long list of Eucalypts and Pines produce among them many shades of dark green and many different leaf-forms and habits of drooping. Plane (Platanus), Poplar (Populus), Catalpa, (Fig. 32) Ash (Fraxinus), Oak (Quercus) (Fig. 31), Lirodendron (Fig. 79), Ficus, Magnolia (Fig. 82), White Mulberry (Morus), Robinia, Gleditschia, Bauhinia, etc., introduce many new leaf-forms and colour-shades; while the Crimson Oak (Q. coccinea), the Purple Plum (P. pissardii), and the autumn tints of several species of Acer (Fig. 29) introduce deep red foliage colours, and several variegated sorts give white

and yellow. The Weeping Willow (Salix Babylonica Fig. 31), is unique in its pendant habit; the Lombardy Poplar (P. fastigiata (Fig. 32), and the Upright Cypress (Cup. pyramidalis), are almost alone in their peculiar upright symmetry; while the larger Bamboos have an erect, yet spreading beauty of their own, productive of striking scenery effect (Fig. 84). Each of these forms, colours, leaf peculiarities, and general habits requires to be represented, but none of them overdone if a first-rate general effect is to be produced, and flowering trees, such as the white, the yellow, and the scarlet Eucalypts, the scarlet Brachychiton, the pink Bauhinia, the white Magnolia and many others also require a place, together with the even more profuse and brighter flowering creepers and shrubs in variety. A mixed and harmoniously blended whole is thus produced by the most dissimilar units; a whole more closely resembling a natural forest than a pure plantation of any one kind of rigid and stately Australian tree ever does produce. But though all this is effective in landscape work it must not be confused with good timber forestry. In Europe it is the practice in forestry to use several species, of different natures, mixed together; and in the natural forests of Natal many slow-growing species are naturally mixed together, which, through the survival of the fittest through many generations, have gradually killed out such kinds as could not accommodate themselves to being crowded or dominated; but in afforestation work throughout South Africa mixtures of fast growing trees have usually proved failures, and the most successful timber plantations are those in which one kind only is used. Each kind has a different requirement of light, moisture, or canopy, and though the mixtures may be theoretically correct, and at some future date actually practicable and advantageous, the present position of forestry justifies only pure, or almost pure, plantation forests, whatever the species may be.

CHAPTER IX.

TREE PLANTING IN THE COAST DISTRICTS.

The coast lands of Natal are, or recently have been, in a great measure tree-clad. This is rapidly changing, bush being cleared out in every direction to make way for sugar and fruit culture.

It may be and is argued that the bush is of low value, and that it makes way for a more paying crop. The natural bush consists mostly of species for which no high class demand has yet arisen, and to a large extent of small or damaged specimens. Coast bush is notoriously a dwarf class of forest, in which gnarled and damaged boles, low-spreading crowns, dominating creepers, and useless soft woods predominate. But except from the sea-dunes this description is often not full and not accurate, and even where it does apply, the result is the product of surrounding circumstances rather than a natural sequence of proximity to the sea. Probably no finer forest of its size exists in South Africa than the Instubane Forest in Eastern Pondoland, situated within a mile of the sea, and containing grand specimens of a large number of valuable indigenous kinds. But there the shelter and the soil conditions are alike perfect, and the position of the forest has also helped to keep it intact.

Throughout lower Natal, however, sheltered basins with suitable soil are conspicuously absent, and wherever they occur the bush has long since passed into private hands, and been removed in favour of sugar or other crops, or simply for sale as fuel for brick works. The more valuable Umzimbeet and Flatcrown has everywhere been marketed as wagon wood if sound and good, and the forest rubbish of rapid growth and no value has closed up the blanks, and left the forest apparently of very low grade indeed. Wherever fresh water is constant the ubiquitous "Umdoni" (Eugenia cordata) may be found, and in the brackish estuaries and lagoons the several mangroves find their favourite site. Sugar and brick-making have removed the better forest-clumps in the vicinity of Durban; the drier ridges which are not suitable for sugar remain bush-clad; and consequently, what bush remains is actually of lower quality than that which originally held the whole district, and of which the poorer portions only are now extant.

In such endeavours as have been made to extend the coast area under trees by artificial plantations, there has also, unfortunately, been such a marked want of forestal success as to discourage others who would be inclined to make further trials.

But such endeavours to afforest the coast have been of the most meagre description, taken up in every case as a hobby or a fashionable pastime, and I am not aware of one plantation which has been laid down on commercial lines with a view to financial returns. The work has consequently been altogether that of the amateur, guided only by horticultural and landscape instincts, satisfied with a picturesque effect, and aiming at nothing more. While such result has beautified and diversified the scenery to an extent probably greater than did the indigenous forests which have been removed, and has introduced an enormous number of exotic species, and shown them to be capable of existence and cultivation here, tree-culture still remains a pastime rather than an industry. The main industries of the Colony are as yet too young to make the public feel what the position will be when the land is exhaused by sugar, and something else has to take the place of that industry; trees have been easily removed, and have paid for the cost of removal, but when it comes to replacing forest cover over derelict sugar lands, considerable difficulty, cost and outlay will have to be experienced to regain even the former bush-clad conditions, and no one will feel himself called upon to undertake the task. That condition, wherever the bush was more dense than thorn-scrub, had a distinct beneficial effect on the climate and rainfall; this has been cleared out often for the sake of one crop of mealies upon private lands and Indian holdings, and even the Natal Native Trust allows natives in the coast districts to clear bush for cultivation without any guarantee that the cultivation will be maintained or the bush replaced by anything better than a weed-patch. Consequently, the bush which for centuries has covered too small a proportion of the surface of Natal disappears, the climate alters in proportion, springs dry up, and thunder storms increase, and no one reaps much benefit, and the public generally have to suffer. There is reason, therefore, in urging that, wherever it can be done with any prospect of success, extended tree-planting should form an industry instead of a hobby, and should be carried on on commercial lines rather than for scenic effect.

The first difficulty usually experienced is as to what kinds should be grown. The kinds which do well in the midlands have mostly been tried, and many of them have proved more or less complete failures. Black Wattle (Acacia mollissima), Blue Gum (Eucalyptus globulus), and Pinus insignis, being the most rapid growers and probably the best known and most easily obtainable trees, have been tried largely, and have generally proved unsuitable. And, because they have done so, it has been assumed that all other species of Acacia, Eucalyptus, and Pinus are also necessarily unsuitable, and in proof of this such kinds as do thrive are pointed to as making only half the growth that these three kinds do in the midlands. But it must be remembered that these kinds are not reasonable as standards

with which other kinds can be compared, since they themselves are practically valueless, as timber, mostly on account of rapid and knotty growth. Kinds, therefore, which grow more slowly but into more valuable materials must be taken as standards in their respective classes, and judged from this standpoint the coast districts are not devoid of kinds suitable for timber production if given favourable soil and site. A visit to the Botanic Garden, Durban, reveals a wealth of timber probably unequalled in bulk, variety, and health in any other garden elsewhere in the same length of time; a collection, too, in which is represented most of the trees likely ever to be of commercial value in the neighbourhood of Durban, collected with unceasing zeal from every likely part of the world, and of the highest value as an object-lesson to anyone who would take up tree planting when he starts to compare the relative merits of different species and their ability to thrive under local conditions. The interest of this collection is enhanced when one can learn from the Director or Curator the history and fate of many species now unrepresented, but which have had their opportunity, and died either through climatic causes or from the White Ant pest (Termite), which must always be considered a factor in tree-growing in the lower levels and hot valleys of Natal.

Many of the species which have proved themselves suited to local conditions have not, however, as yet reached the stage in which their timber value can be tested, and it is therefore necessary to connect with the local growth foreign records concerning the value for technical purposes, of the timber produced. Trees distributed from this garden throughout the district serve to corroborate the evidence of the Garden itself, and sometimes add to our knowledge of the range of soil suitable for a species, or the special conditions more favourable for its economic development.

The most prominent feature in the tree-flora of the Berea, and, indeed, of the whole vicinity of Durban, is the tall, stately and formal growth of the various species of Araucaria. These trees, though not grown forestal-fashion, and though exposed to every wind which blows, have produced grand trunks as straight as the best forest Pine, and practically mature at 30 to 40 years of age. These trees, which form striking objects in any landscape do not naturally grow into dense forests; they rather enjoy to stand out prominently and singly above any other vegetation that may surround them. In addition to this, the cost of plants has till recently been prohibitive against close planting. But the timber of Araucaria is likely to be, sooner or later, the main pine-wood of the Natal coast, and the way to make it so, and at the same time prevent undue branch formation, and avoid waste of plants by planting what would afterwards have to be thinned out, is to plant the Araucarias as far apart as will allow them to mature, and to fill up the intervening space with a cheaper and much slower tree, such as, for

instance, Pinus pinaster, which can be sown broadcast between the Araucarias and thinned out as necessary, the loss thus being less, but the forestal effect better than if the plantation were one of pure Araucaria. The species and their relative merits are discussed in Chapter XV. They do not require rich soil, but they do require a reasonable depth of it, whether sandy or alluvial, and object to clay or shale subsoil.

Pines do not assert themselves so prominently as the Araucarias, and there is a belief prevalent that White Ants usually kill them off while young. Pinus insignis, P. longifolia, and P. excelsa may safely be omitted in any selection for the coast, but P. pinaster, P. halepensis, and P. canariensis deserve at least further trial, if not, indeed, extended cultivation. Pinus pinaster (P. maritima) is grown extensively in South Europe in the reclamation of coast sand-drifts, and in the Cape Colony it is cultivated with a view to sleeper production more extensively than all other trees together. In Natal there are only occasional trees to show that it can be successful, but these are scattered from the coast upward, and an extensive test plantation is necessary before it can be denounced to the extent it has been. Its cultivation on the shallow shale ridges, where it has usually been placed, can only result in failure, but on the poor open sandy flats, of which there are large tracts on the Natal and Zululand coasts, no tree appears to me more likely to succeed in extensive forest work.

Pinus halepensis also does fairly well, though it is more susceptible to wind influence than P. pinaster. Pinus palustris (P. australis) also promises well, and there are many other American and Asiatic species which have not yet been tried, and from among which some successful kinds may be selected after trial.

The Pines more than any other class of exotic trees form humus and forest soil; they also do more toward cooling the atmosphere, condensing moisture from the clouds, and retaining whatever moisture they condense than any other class which can come in for general timber production, and their timber forms nine-tenths of the total timber demand of the world, as well as of the timber import into South Africa. There is consequently every reason to experiment, even through repeated failures, until some timber-producing species of this class is found amenable to simple cultivation. For it must be remembered that though Cluster Pine (P. pinaster) had established itself a good many years ago on the Cape Peninsula and at Genadendal and elsewhere in Cape Colony, it is less than twenty years since this species began to be sown broadcast there with complete success, and where millions of these trees are now successfully raised annually by sowing *in situ*, hundreds were at that time only planted with difficulty, and kept alive only with watchful care. Whether the same pro-

cess can be adopted on the sandy coast belt of Natal remains to be seen, but thus far is has not even been tried. Another tree of the same class is the Kauri Pine of New Zealand (Dammara australis), specimens of which in the Durban Botanic Garden give much promise. Like Yellow-wood, its timber has a tendency to warp, but it is nevertheless ranked as a first-class pine timber, and one certain to find a demand. The tree likes a heavy rainfall, deep soil and reasonable shelter, as its young shoots are brittle and apt to be damaged by wind. With these conditions it may be expected to succeed on the Karkloof and Ingeli ranges, but it is not at home in the hot, dry and shallow soils where mimosa occurs naturally.

Among hardwoods only a few species have proved successful, though the choice of soil usually given them may have to do with the many failures. Shallow ridges are distinctly uncongenial to most hardwoods, especially Eucalypts, and it is surprising to see so many species even keeping alive on them as there are.

Eucalyptus paniculata, the White Ironbark (which has received the local name of Torr Vale Gum along the north coast), stands out pre-eminently as the tree best able to endure whatever conditions may be given to it on the coast. It has the further advantage of having perhaps the highest Australian reputation as a sleeper timber, the price of Ironwood sleepers being usually higher even than Jarrah, and if only one species is to be grown in Natal for sleeper purposes, this should be the species, and it should be grown on the coast or midland districts. It is not the most rapid grower in any locality, but it is more safe on unselected soil than any other, and if the experience concerning most kinds in most countries holds good in regard to this species, what it loses in rapidity of growth should be made up in quality of timber when grown under rather adverse soil conditions. On fresh alluvial soil it is rapid and clean; on poorer and more stoney ridges it is slow and apt to branch freely, unless prevented by close planting. Probably the resin in its bark is not relished by white ants, at least it is less damaged by them than most other Eucalypts, though it congeners E. sideroxylon and E. crebra share this quality, as also durability of timber with it. Another species which withstands white ants well is Eucalyptus citriodora, the lemon-scented gum, tropical in its nature, and still producing timber of technical value for wagon work, etc. This species is distinctly poor where depth of soil is absent, but may in absorptive power be considered the coast substitute for the more hardy Blue Gum (E. globulus), which does badly on the coast.

Eucalyptus robusta, Swamp Mahogany, is another species which deserves extended culture in the malarial swamps, if only on account of its absorptive power. Its timber does not rank with that of the two preceding species, and though not without

economic use for timber, it is for swamp drying, and as a shade tree where there is abundant moisture, that this species can be recommended. There are miles of rush-clad mud-flats behind the sea dunes between Umgeni and Durban which could be dried by the use of this species, and changed from a pestilential swamp into a healthy pleasure park.

Eucalyptus rostrata, E. tereticornis, E. corymbosa, and E. saligna are other valuable timbers suitable for coast culture, and E, microcorys, the Tallow-wood, is sufficiently valuable to be worth extensive trial.

The Karri (Eucalyptus diversicolor) is admirably adapted for many coastward situations where deep soil is available; its timber is being imported largely meantime from West Australia, and used for sleepers and for harbour piles, though for the former purpose its suitability is doubted, the timber weathering in shreds like stringy-bark.

There is, however, another class of timber known as Cedar-woods, for which the coast districts are as suitable as they are for either soft-woods or hard-woods.

These timbers are produced from several genera having little botanical relationship. The true Cedars (Cedrus) do not thrive on the coast, but the Pencil Cedars, Juniperus Virginiana, and Juniperus Bermudiana make better growth there than elsewhere. The former is rather of slow growth, but capable of enduring a very dry rocky site in almost any Natal climate; the latter grows more rapidly, and is more distinctly tropical in its nature; both branch too freely, and require close planting or intermediate nurse plants of less value to draw them up. These timbers are sufficiently valuable to stand exportation to Europe if they can be grown clean and clear of knots.

Several species of Cupressus also yield cedar woods of value; indeed, all Cupressus species yield valuable timber when properly grown. They have, however, a decided tendency toward an undue production of knots, and to prevent this they must be made to undergo a struggle for existence either among themselves or among nurse trees. C. lusitanica and C. pendula-glauca thrive well on the coast, but they require reasonable depth of soil; C. macrocarpa does well for a time on deep soil, but has a tendency after ten or twelve years to die out unexpectedly; while C. horizontalis seldom fails, and it is less liable than the others to produce an undue weight of branches, but like the other species, demands depth of soil.

Cedrela yields another timber of this class, though very different in foliage, which is not unlike that of the walnut. Several species do well here in suitable localities, depth of soil and reasonable shelter being required, though intermixing them with Eucalypts has not been a success. C. australis, the Australian Red Cedar; C. odorata, the West Indian Cedar; and C. Toona, the Toon tree, all promise well on the coast, and the former does well up to Maritzburg.

Casuarina leptoclada yields a white useful timber for boards and such purposes, and grows well from the coast to the Drakensberg. The different species of Casuarina vary exceedingly in their habits of growth and timber value, some having beautifully grained red timber and drooping habit, others more upright growth and white timber. The kinds are well known to growers, but the nomenclature and synonomy are most confusing.

Teak (Tectona grandis) makes slow but steady growth, but its cultivation is too limited to warrant a verdict on its value in Natal; probably it will still take an important place among the timber trees of the coast.

Grevillea robusta, the Silk Oak, though usually grown as an ornamental tree, produces a very pretty furniture timber, closely resembling in its markings the well-known sugar bush (Protea), but growing into timber size, stems 2 ft. in diameter being in local evidence. It requires a certain amount of shelter, and a good depth of soil; when these are absent it is apt to be attacked by scale, and to become rugged and leafless, though in suitable localities its foliage is very ornamental, and its clusters of yellow flowers borne in profusion.

There are several indigenous trees which are worth notice for timber production. The M'kuhlu, or Natal mahogany, (Trichilea emetica), grows rapidly into a tree; many fine specimens still remain in and around Durban, though the finest trees known to me are in the Transkeian and Pondoland coast districts, whence slabs three feet in width and of great length are obtainable. These are found most useful in furniture work, the only fault being that unless they are seasoned in water they are apt to become worm-eaten at an early date, though that process makes them permanently worm-proof. This is also the case with regard to Esschenhout (Ekebergia), another soft white planking timber.

Flat Crown, which is of rapid growth and always in demand for naves, is easily cultivated, and may by care be kept free from the defects so common in the wild condition; and Milkwood, Hard Pear, White Pear, and Umzimbeet are of value if they can be grown straight and clean, native bush being almost always defective in these qualities.

Shelter is very important in exposed localities, and usually is most necessary on hard dry ridges where trees do not naturally thrive. Selection of kind then comes to be of importance, for though almost any species will thrive and give shelter in an alluvial valley, only a few kinds do so well upon a knoll. Where there is very little soil indeed, Juniperus virginiana and Pinus halepensis are almost the surest to do well; where the soil is deeper Cupressus lusitanica is usually successful; where it is damp and sandy the Wild Fig ("Uluzi") grows luxuriantly, usually as an epiphyte at first, but afterwards as an independent tree after it has killed its host in its close embrace. It is, how-

ever, easily struck by large truncheon cuttings. Gums, Pines, Cupressus of kinds, Grevillea robusta, and indeed almost every other ornamental tree, can be used for shelter if selected to suit the site. A few miles inland Black Wattle (Acacia mollissima) is the favourite shelter tree, but it does not succeed close to the coast, where, however, other species of Acacia take its place, including A. cyclopis, A. saligna, A. melanoxylon, A. longifolia, A. spectabilis, and others, differing among themselves in form, leafage and colour, the flowers in all cases being some shade of yellow, but the foliage varying through dark green, light green, and glaucous to nearly white. But where Black Wattle is employed, and, indeed where almost any tree is employed for shelter purposes, there is a decided tendency to place the mass of trees too near the buildings. A few spreading single trees of dense foliage and umbrella form are a decided acquisition near any house, but if these are to be ornaments they must each show its individuality, and the main breakwind must be placed at a considerable distance away, the exact site, however, in each case varying with the local surroundings.

Shelter by hedges is all that is required close at hand, and in species fit for forming hedges the coast district abounds. The hedging plant of the Natal Coast is the Amatungula (Carissa grandiflora), which even in nature assumes a regular and ornamental form, but also has the further advantage of being exceedingly prickly, and consequently proof against almost anything; it endures frequent clipping, and soon recovers active growth; it is evergreen and lasts for many years, and it produces a pretty fruit which is in demand for use as preserves.

But there are many other plants useful and ornamental for hedge purposes which do better near the coast than inland. Among these may be mentioned the dwarf Bamboo (B. Fortunei), the Pommegranate, Cestrum, Tea, Privet, Arbor-vitae, Frenella, Juniperus virginiana, Cupressus macrocarpa, etc. But if large shelter trees are not required in quantity close to a homestead, there is no reason why fruit trees of the comparatively dwarf ornamental class should not occupy such a position. The Mango, The Jack, the Mangosteen, the Litchi, the Guava, the Persimmon, the Avocado Pear, the Papaw, the Custard Apple, the Cherumoyer, and all the various Citrus fruits, and other less common or less useful tropical and subtropical fruit trees give a wide range of selection from which variation in form, size, habit, fruit, and colour may alike be picked, and almost every class of soil and situation supplied with an ornamental and useful tree adapted to itself. As an ornamental tree, a healthy orange bearing a full crop is difficult to beat, except, indeed, it be by a mango, with a flush of young leaves coming on, while for dense heavy foliage and abundant shade, the Loquat takes first place on good soil. Fruit trees, even if grown for the combined purposes of ornament and utility, are usually

grouped more or less regularly, and consequently give a more formal and less picturesque effect than if they can be introduced singly among other trees planted rather for landscape beauty. Still there are advantages in having the fruits planted together, and the ornamental trees dotted singly sufficiently far apart to show the individuality of each. For this purpose the number of exotic species available is so large and their characteristics so varied that a paper will be devoted to them alone in a future chapter. But it must be noted that everywhere in the vicinity of the coast the exotics only give finish and polish to the landscape, of which the main picture is produced by the indigenous bush, and that on the Berea and Bluff, and, indeed, anywhere in the vicinity of Durban, the indigenous bush presents a varied beauty free from all formality, which is difficult of attainment with introduced species; also that selected specimens of indigenous kinds freed from the surrounding mass, and given an opportunity to develop, do produce trees as ornamental as any exotics, though, perhaps, more similar in general outlines owing to the prevalent flatheadedness induced by coast winds, and which only the Araucarias seem able to ignore.

One class of exotic plants, viz., the Bamboos, come largely into the domestic economy of the coast, not only for use as shelter and ornament, but also for their timber, which is used for many purposes, including hut building, fencing, making fruit boxes, etc. They do well on any fairly deep soil, from the coast to about 4,000 feet altitude, though they prefer being near swamp; they have immense absorptive powers, and dry the ground in their neighbourhood so that other things do not do well under or close to them, but they are effective and useful, and where space can be afforded, should never be omitted, especially on wet land. There are many species, of which only the larger are well known, but smaller kinds variegated in various manners are equally as ornamental for their size as the larger kinds.

Apart from Araucarias, it is not the timber trees which give the coast district its tropical character of vegetation, for the Eucalypts, Pines, Cypresses, Beefwoods, Acacias, Grevillea, and others of that nature, are more characteristic of the inland Yellow-wood zone than they are of the coast. Even some of the indigenous trees and plants, such as the Flat-crown (Albizzia fastigiata), the Umkuhlu (Trichilia emetica), the Wild Banana (Strelitzia angusta), the Ilala Palm (Hyphaene crinita), and the Wild Date-palm (Phoenix reclinata), are more strikingly tropical or sub-tropical in aspect, especially when intertwined with monkey ropes, than any of these exotics. But though these produce a distinct effect of their own, seen to advantage along the South Coast Railway, that effect is increased and made more decidedly tropical by the addition of some other exotics, some of which are useful as well as ornamental.

Palms are unique in their effect, even though varied in their habits and habitats. Durban owes much of its beauty along the gardens adjoining the Esplanade, and the North Coast railway much of its beauty along the streams, to the Wild Date-palm, Phœnix reclinata, which though of little economic value is of the highest importance in producing scenic effect, growing as it often does in dense clumps, each stem five to fifteen feet in height, and clothed or surmounted with graceful pinnate arching foliage. This palm likes to have its roots always reaching water, and is one of the best indications of subsoil moisture when growing where other surface indications are absent. But in stately beauty as well as in utility its claims are small when compared with the lofty Date Palm of North Africa and South Asia, Phœnix dactylifera. Many specimens of this exist in and around Durban, one well-known tree being in the garden in front of the Royal Hotel (Fig. 92), but though tropical in appearance it is one of the most hardy palms, fine specimens being in evidence in Capetown, while one at Kat River, Cape Colony, occupies a hot valley just below Katberg, on which snow often lies for weeks. The Date Palm luxuriates in hot, dry desert country, where its roots can strike water—whether fresh or brack is of little importance. Egypt and Arabia are its native habitat, and there it is said to fruit better in the hot, dry interior than near the coast. Probably the same will be found here, and it may prove more profitable in the hot valleys of the Umkomaas, the Tugela, and the Umfolozi than on the coast, though in growth at least it has thus far done well on the coast. It is diœcious (*i.e.*, the fertile flowers are on separate trees from the male flowers), so several trees should be grown together to ensure fertilization. It grows easily from seeds taken from commercial dates, but the plants grow slowly at first ,and seedlings often fail to maintain the reputation they have had in Australia and California of fruiting while quite young. On the Mediterranean coast many named varieties are cultivated, having different fruit-forms and different seasons of bearing; the fertile trees of these are propagated and maintained as distinct varieties by the use of suckers, but seedling male trees are satisfactory.

The Date Palm grows to a height of nearly 100 feet, and will probably be an important article in the drier portions of Zululand. None but seedlings are as yet grown here, but Government is making an endeavour to obtain suckers of best fruiting kinds from Egypt.

Another stately and important palm is the Cocoa-nut Palm (Cocos nucifera), which also is successful in and near Durban. An old tree in the Botanic Garden is meantime carrying fruit (Fig. 53), an Indian's yard near Greyville contains many fine specimens, and on the Durban Esplanade many young plants are doing well. At the Umvoti Mission Station there are also fruiting specimens. The Cocoa-nut is

much more distinctly tropical in its requirements than the Date Palm; naturally it is usually found on sandy sea shores, along lagoons, or on islands in the ocean, where sea spray is frequent, and even brack-water at the roots is not uncommon. Taking into consideration how well the Cocoa-nut thrives around Durban, it is only reasonable to expect that on the sandy hills between the Umhlatuzi and the sea, and northward from there through Lower Umfolosi, Hlabisa, Ubombo, and Maputa, its fruit will in time be one of the main products, and give a permanent crop in a district where, from climatic reasons, constant cultivation is not attractive. Government has imported plants and seeds lately which are being grown at Empangeni Nursery for use in Zululand.

There is already in the same belt of country another palm not yet identified, growing to a height of 40 or 50 feet, and producing fruits in abundance, like miniature cocoa-nuts, which, together with those of the more common "Ilala," *Hyphœna crinita*, are known as vegetable ivory, and used by the Natives as such.

Many other exotic palms are common in gardens round Durban, whose Botanic Garden has introduced and distributed many grand scenic as well as economic plants. One of these, *Cocos plumosa*, is shown in Fig. 53, and others are equally striking objects in the Botanic Garden, and throughout the coast belt.

Another striking feature of the coast is the Screw-pine, *Pandanus utilis* (Fig. 91), a branched and somewhat palm-like plant, which, though more ornamental than useful, has in its native countries—Bourbon, Mauritius, etc.—a reputation for the production of fibre from the leaves for use in the making of cordage, bags, etc. It is hardy where there is no frost, but is most luxuriant and produces its large pine-like cones most profusely near the sea.

Of a different nature altogether, but none the less tropical, are the heavily foliaged evergreens, of which many exotics are in cultivation.

One of the best known of these as a cultivated foliage tree everywhere in the tropics and sub-tropics, as well as in the conservatories of Europe and North-America, is the Indian *Ficus elastica*, the source of Asiatic India-rubber. It enjoys a moist, close atmosphere, but is not adverse to drier climates so long as the root supply of moisture is sufficient. Healthy young specimens in the Albert Park, Durban, are shown in Fig. 86, where, curiously, it is mixed with the indigenous Yellowwood (*Podocarpus*) (Fig. 86), but it is frequent as far inland as Maritzburg, and as far south as Cape Town. Tapping for rubber has not been tried in this country; indeed, here it is only grown as an ornamental tree, but in Assam it produces an enormous value of rubber yearly. The flow and the quality of its rubber varies with the locality where it is grown, and especially with the rainfall; to test it here a small

plantation is now being planted at Empangeni. A somewhat similar Fig is grown in Durban under the name "Mpai" (Fig. 89), from which latex flows freely, and probably it is the same species which yields one of the caoutchoucs of Amatongaland, recently tested by the Imperial Institute experts.

Another Ficus, the Banyan, F. indica, shown in Fig. 53, is an important shade tree in India, and many other species of Ficus are highly ornamental in their foliage, including one with variegated leaves, F. Parcellii, which grows to tree size.

The most valuable rubber from Amatongaland is that derived from a creeper, Landolphia Kirkii, the monkey-ropes of which, from one to six inches in diameter, surmount the largest trees where they occur, and, consequently, it is rather unmanageable as a cultivated plant, except grown among other trees on which it can climb. It is not known to occur naturally so far south as St. Lucia Bay, but probably does do so; a plant in the Botanic Garden, Durban, has made satisfactory, if rather slow, growth, and a plantation of this is now being planted along with other tender kinds at Empangeni.

A more hardy variety is the Ceara Rubber, Manihot Glaziovi (Fig. 52), which comes from a comparatively dry part of Brazil, and which has been in cultivation, experimentally, in Durban for many years, though the culture has not yet caught on as a commercial speculation. Its large flat leaves, hardy nature, umbrageous habit, and early production of latex are in its favour; in the dry hot parts of Zululand it may yet find its merits recognised. Seeds have been produced in Durban for many years, but have mostly gone along the east coast north of Zululand.

Poinciana regia, the *Flamboyant* (Fig. 90), is one of the most gorgeous trees we have, its profusion of scarlet flowers set in abundant light green feathery foliage being rivalled only by the Spathodea speciosa (The Flame Tree), which, however, has an erect habit, while the Flamboyant takes naturally the level top and weather-beaten appearance of the indigenous Flat Crown, Albizzia fastigiata. Its timber is of no technical value.

Another tree of similar habit, but usually rather smaller size, is the Jacaranda mimosaefolia (Fig. 52), in which the flowering is equally profuse, though the colour is blue instead of red. The tree is deciduous, and the flowers produced mostly when the leaves are off. The timber is said to be valuable. A tree used largely in Durban as a shade tree, especially in the streets, is the *Umlolwa* Hibiscus tiliaceus (Fig. 85). It strikes readily from pole-cuttings, forms a bushy-headed small tree of dense umbrageous foliage, and has the further charm of producing numerous large yellow flowers. It is indigenous along the sea shore almost throughout the tropics, and does best within a few miles of the sea. Its bark can be used for fibre purposes, but this has not been made an industry as yet. For areas almost or quite subject to being occasionally

tide-swept there is no better tree, unless it be one or other of the Mangroves, which naturally claim tidal mud as their habitat, and do not succeed under any other condition. Another indigenous tree requiring a similar habitat, though successful in coast swamps which are not distinctly saline, is Barringtonia racemosa, whose heavy foliage, resembling that of the loquat, racemes of white flowers and conspicuous fruits make it worth cultivation in any garden sufficiently wet to suit it.

The trees described above are only a few of the numerous tropical or sub-tropical kinds which adorn the coast district of Natal, and which are worthy of more extended cultivation than they at present receive.

CHAPTER X.

TREE PLANTING IN ZULULAND.

As Zululand presents several features in which it differs from other parts of Natal, its tree planting peculiarities must also be considered separately. Like Natal, it varies much within itself, ranging from temperate conditions, similar to those of the Drakensberg, to tropical conditions in Maputaland. In so far as planting for ornament or shelter is concerned, what has been stated in the previous three chapters holds good equally in the similar localities in Zululand, but for commercial planting its area may be more satisfactorily classed as containing two districts only. Of these the upper represents the midlands of Natal, and on all the eastward slopes is quite within the mist belt and natural forest-belt, which has already been referred to as traversing the whole of eastern South Africa within seventy miles of the coast. It is naturally a wet country, subject to heavy summer rains, and also to occasional winter rains, or, in the higher parts, snows. These render the district in winter even more suitable for tree-growth than the midlands of Natal; as a consequence natural forests are frequent, though those now extant are only a small relic of what have once been. The removal of timber, hut wattles and fuel have sufficiently opened many bushes to allow fire to pass through; this was followed by the formation of mealie-gardens on the debris, and increased danger to what remained. Large areas now devoid of trees have formerly been under forest, and would easily be afforested again if circumstances allowed. Until the delimitation and settlement of Zululand are completed, however, little can be done to give practical demonstration of this, holders on short or insecure tenure being unwilling to expend money on tree planting from which they may reap no benefit. Enough has been done, however, in and around the Mission Stations and stores to give evidence that the country is well adapted for afforestation, and that if there were inducement to plant the trees would grow. The difficulty meantime is transport, and so long as there are no railways in proximity the harvesting of timber can hardly be undertaken. Land transport is always expensive, especially for an article weighing so much compared with its value as timber does, and in this case it has to be considered that, even after land haulage, the material is likely to be landed on the coast railway while the demand is up-country. Meantime indigenous timber is being worked from Qudeni at a

killing cost for cartage to Dundee, and plantations which will involve 70 to 100 miles of cartage, when mature, are not worth consideration. But timber is one of the best feeders for developing railways, and if enough timber of kinds in demand can be better grown in Zululand than elsewhere then when quantity is available a railway comes as a natural sequence. Tree planting as a commercial enterprise, therefore, demands in upper Zululand a faith in the future of the timber industry there to lay down a sufficient area or areas in proximity, to be worth, or at least, to be a strong incentive toward railway development to that part within thirty or forty years. Scattered work can only result in regret afterwards that the timber cannot be reasonably realised, and any plantation schemes should see the possibility and probability of railway communication before being taken up. As the Government is likely to be the largest landholder (except the Native Trust also comes in), and as other owners will in all probability farm stock before they commence extensive tree planting, it falls naturally to Government to reserve and afforest a large area within the mist belt to make up for what should have been reserved in Natal, but was alienated long ago, on which to grow the timber now imported. Almost the whole of the Nkandhla district, except the deep, hot valleys, is admirably adapted for the culture of pine timber, and of high quality Eucalyptus, and could at comparatively small cost be afforested meantime, and brought into communication a quarter of a century later, when material is fit for sending out. The Qudeni plateau, the Tetabulani slopes, the neighbourhood of Nkandhla Magistracy, the Nkandhla mountain, Sipudeni, and Nkomo, are all ideal sites for plantations, and if railway communication were established would also be equally suitable for Black Wattle culture, though it seems doubtful if the timber of Black Wattle can ever be of value from there except some new development in its utilisation first comes in. Nor less valuable for plantation purposes are the districts extending from the Nkomo to Entumeni, Eshowe, and Ngoya, though these being at a much lower elevation are more sub-tropical in their indigenous vegetation, and suitable for many varieties almost excluded from Natal through the geological features of the Natal coast. The climatic, as well as the geological, conditions in this belt are exceedingly favourable for tree culture, and while not excluding Black Wattle, or valubal Eucalyptus, are also fit for the extensive cultivation of Araucarias, Ficus elastica, Citrus fruits, Bamboos, and many other sub-tropical subjects. Much of this should be occupied by Government afforestation in extensive plantations, sufficiently extensive indeed to be ultimately worth a saw mill, a creosoting plant, and even a pulping plant at each.

Some of the indigenous timbers may also be used to advantage in this belt, especially the Mkuhlu (Trichilia) and the Esschenhout, which, on deep light soil run rapidly into bulk

of soft planking timber, the Flat-crown, which is always in demand for naves, and on the harder ridges the Umzimbeet, which, throughout Natal, is almost cut out.

Whether or not Ficus elastica will be found to be a paying rubber in this district remains to be seen; that it will grow rapidly and reliably is certain. But, as with most other rubbers, rapid growth does not always indicate a heavy flow of milk, and though this district gets a rainfall heavy for Natal, it is still light compared with that recorded where this tree gives best results. If, however, the rainfall is not enough for Ficus elastica it is the more likely to suit the Ceara Rubber (Manihot Glaziovii), which, coming from the one comparatively dry part of Brazil, is likely to have its requirements met here.

Northward from this belt is the valley of the Umfolozi, mostly too dry and hot for tree culture on an extensive scale, though suitable in restricted areas to the growth of the Date Palm, the Litchi, the Mango, and others requiring similar conditions.

But it is more particularly on the tropical coast belt that the peculiarity of the Zululand climate comes in, for there conditions differ much from Natal. The southern part, i.e., from Tugela to Ginginhlovu, has nothing attractive to the tree planter in it; for the greater part it is too dry for anything except summer crops, and even these are rather restricted in area. But from Ginginhlovu northward the whole coast belt is admirably adapted for tree planting, much of it being better suited for that than for any other purpose. It varies from open lagoon, through swampy bulrushes, swampy reeds, swampy rushes, swampy and sandy grass lands, sandy dunes more or less bush clad, and Umdoni tree patches, into occasional small areas fit for sugar and a few rolling hills too stiff and hard for most ordinary purposes, on selected spots of which the few Natives grow their mealies, sweet potatoes, and Kafir corn, and umdumbe. Light sandy soil predominates, usually too wet for successful culture, and there is always a danger that if the wind once breaks through the dunes a vast area of what is now lagoon will be put under a living sand-drift, so mighty is its power that though the present condition of these flats is not a paradise, it is much to be preferred to what would then result. These sandy flats extend more or less continuously to the Portuguese boundary, and are, northward, from 20 to 30 miles wide, with only occasional high ridges thrown in, the wet condition, however, being replaced in many places by extreme surface dryness, with subsoil moisture at an easy depth. The district is all more or less malarial; even the Natives find it so, and in consequence are fewer there than elsewhere, and less inclined to work. To what extent extensive tree planting would improve the hygenic conditions of these flats is a subject on which opinions differ, but I am satisfied that vast areas which are

meantime wet could be rendered dry by the use of trees, and not by any other practical means, the levels being harldy such as would allow of useful ditching, while the growth is too vigorous to allow ditches to remain long open.

With reference to what can be grown there the locality is one which does not correspond closely with any other similar area in the world, and there must, therefore, be a large amount of experimental work in whatever is first done there. That the conditions will suit a large number of species of trees, useful for timber, rubber, fruit, and other purposes, is certain, but which of these are best worth taking up is a matter which experiment only can settle. On this account Government has this year started a test plantation at Empangeni, where trees in variety are being raised and planted out, with a view, before close settlement comes in, to afford the public some proof of what is most likely to succeed, and of what has been found to fail, for the failures tell more than the successes. Swamp reclamation trees take first place, and among these the various sub-tropical Eucalypts occupy a leading place. Probably no Eucalypt will live in actual swamp, but by throwing up a mound, or a ridge, on which the young plantlet can make a start, and from which it can throw out feeding roots into the swamp, a condition is raised quite congenial to many Eucalypts. The one best known in this connection is E. robusta, the Swamp Mahogany, which, though of comparatively low timber value, is largely used meantime around Durban in somewhat similar localities, does well, and produces a luxuriance of foliage which alone indicates an enormous absorptive power. E. maculata and E. citriodora have similar ability to stand in such localities, united with the production of valuable timber, while others, like E. tereticornis, E. rostrata, E. microtheca, E. saligna, and E. amygdalina, can endure the climate and moisture if planted on a fairly high bank, and the gigantic Karri (Euc diversicolor) and the Black-butt, E. pilularis, both love such climatic conditions and abundant moisture, and are well worth trial in this locality.

Among the indigenous trees the several wild Figs all affect swampy spots, and though practically useless for timber, these may have a value in this connection., But if the exotic Ficus elastica can be grown near enough a swamp to live on it without being actually in it, there seems a prospect that its rubber-producing qualities may be duly stimulated. Another Ficus, the Mpai, native of Maputaland swamps, enjoys such a situation, and is found to yield latex in quantity though of low value. Most Ficus species strike readily from large truncheon cuttings, which method at once places their foliage above the vigorous undergrowth, and there are a large number of species suitable for sub-tropical swamp conditions as shade and ornamental trees, though of low technical value. Among these the Banyan, F. indica (Fig. 53), the Moreton Bay

Fig, F. macrophylla, the Assam Rubber, Ficus elastica (Fig. 86), Ficus religiosa, and the several indigenous species are the best known.

For thoroughly wet saline swamps, or lagoon margins, the Mangrove, Rhizophora mucronata may be worth extensive introduction. Its bark has a low value for tanning, and its poles are largely used on account of being white ant proof.

Another class of trees suitable for these swamps are the Willows (Salix), of which most species affect moist, if not actually wet, land, and some are useful for timber, and others for the production of osiers. The behaviour of the various species under tropical conditions has yet to be proved. The Divi-divi, Caesalpinia coriaria, which belongs to tropical swamps, produces pods largely used in tanning. Several species of Casuarina are used in somewhat similar localities, especially C. equisetifolia, but does not stand to be water-logged.

Bamboos also are useful where ground not actually water-logged is to be had, and the technical value of the Bamboo is only beginning to be known here.

Coastward of the lagoons, and north and south of them, there extends a belt of more or less bushclad dunes along the coast; these are sandy in nature, high and dry on the surface, moist underneath, and sufficiently protective against wind to render the valleys behind them ideal spots for tree culture. What valuable species will succeed on these grassy glades has still to be proved, but it is safe to assume that many valuable Indian trees, as well as trees from other parts of the sub-tropics, are likely to succeed here if they are to succeed with us anywhere. The Cocoa-nut (Cocos nucifera Fig 53) may be considered safe along this sandy belt, and will, no doubt, be an article of extensive commerce in the future. The Araucarias may also be relied on to yield a crop of valuable coniferous timber from land which is not suitable for any ordinary agriculture, and which will be improved in quality by carrying such a crop. It is also probable that Eucalyptus gomphocephala would be quite at home in this, and yield a crop of valuable hardwood. Casuarina equisetifolia and C. quadrivalvis, and Terminalia catappa (Fig. 45) are also suitable. Rising somewhat from the lagoons on the landward side, where the soil is not too stiff, a much larger selection of kinds is open to us, including all those already mentioned. Here the Araucarias may form one of the main features for the production of pine timber, but as plants are rather rare I recommend planting them at the espacement they would require when mature, say, at least 20 feet apart, and filling in for the first few years with a cheaper and less valuable kind destined to be removed before maturity, as soon as it has served its purpose, in drawing the Araucaria upward, and leaving it clear of lower branches. Many kinds answer this purpose, probably Ceara Rubber would do as well as any, and yield its

product for several years before being cleared out. Bananas may also be suggested, or a mass of Cluster Pine, sown broadcast, if that treatment is found to answer there, these being fit to remain should gaps occur in the main planting. It must be distinctly understood, however, that this intermediate crop is only intended as a temporary means to produce a desired effect, and as soon as the Araucarias are requiring room these others must go, whether mature or not. The Kauri (Agathis australis) (Fig. 37) is another tree worth similar treatment, at least experimentally, its further culture to depend on early results.

Pine trees are usually condemned on the coast. This sweeping condemnation appears to me premature, for Pines have seldom received pine-culture on the coast, and it seems probable that fire more than all other causes accounts for the limited number of mature specimens. The kinds which have been tried are few, the kinds available are very numerous, including those from Florida, Texas, Mexico, Central America, India, and elsewhere, of which seed has not yet been available, but which should form some of the first experimental work there. I have avoided recommending what has not been tried, and so in this group can only recommend experiment. The kind which has not been successful on the coast is P. insignis, the others are mostly condemned on that failure. But P. halepensis usually does well, and P. pinaster has also succeeded fairly well wherever it has had an opportunity. Pinus australis and Pinus Canariensis will probably also succeed, but are practically untried in lower Zululand.

But if there is room for doubt with regard to the ultimate success of the Pines in this district, there can be little in regard to the class of trees producing what are known as Cedarwoods. These are not, by any means, all Cedars; indeed no species of Cedrus is successful on the coast; but the same class of timber is produced by several other genera more successful in this climate.

The several species of Cupressus, especially C. lustanica, C. horizontalis, and C. torulosa, with their varying forms, succeed well, and if kept clear of branches produce first-class timber. Juniperus Virginiana and J. Bermudiana, though of slower growth, are also sure and valuable, while the species of Cedrela known as "Toon" in India, and as "Red Cedar" in Australia (Fig. 49), promise well indeed. It is probable that Teak (Tectona grandis (Fig. 49) may also be worth trial, though thus far the specimens on the Natal coast have not done very much. All the above are timbers from which sleepers and house-building material can be manufactured, in case no higher class demand exists (some with, and others without creosote), but it is among the Eucalypts that sleeper timber may be most easily raised. E. paniculata (Torr Vale Gum), E. sideroxylon (Ironbark), and E. crebra (also an Ironbark) are among the best sleeper materials known, and all these, as well as the

kinds already referred to, and many others, suit the district under discussion. Large Eucalypt plantations, as well as large Coniferous plantations, should occupy lower Zululand, in preference to sugar, cotton, or even Rubber. Rubber has, however, attracted some attention in Maputaland, from the the fact of its growing wild there. The species giving most promise of value is the Landolphia Kirkii, the Ibungu vine of the Natives, scattered more or less throughout the drier parts of Maputaland, and extending south as far as the Mkusi River, and probably further. It is a rampant creeper, requiring the support of thorn scrub or other bushes, and does not occur in the moist swamp forests. As a natural product there may be a considerable, though as yet ill-defined, value attached to the rubber-fields of Maputaland, but there can be no doubt that extensive culture alone can give this plant the commercial value which evidently it is intended to bear. The culture has all to be learned as yet, for though the same species extends north along east and west Central Africa, and yields an enormous value of rubber there from wild plants, its culture has nowhere been taken up. How many years it will take to grow to latex-yielding size, what is the best age and size for tapping, what are the best methods of propagation and of training, and many other interesting questions, have all to be worked out by patient experiment. But meantime all that can be said is that it seeds freely, that the seeds are short-lived, that seedlings transplant without difficulty when well cut back, and that rather dry sandy ridges are its favourite home. A plant in the Botanic Garden, Durban, planted in 1892, lives and thrives, but having no opportunity to climb has not had a chance to show its normal development. Another species, Landolphia florida, grows there alongside of it, showing larger leaf and greater vigour. Both species yield rubber, as also do several other African Landolphia species. The experimental cultivation of these Landolphias is intended to form an interesting feature of the Government Plantation at Empangeni, where, so far as is known, they are not indigenous, but where supervision and labour are not so difficult as at Maputa.

The extensive cultivation of L. Kirkii in its native habitat in Maputaland (as distinct from tapping wild vines) will always be a matter of considerable difficulty so long as that country remains inaccessible and severely subject to malaria.

The cultivation of other rubbers, on the other hand, may be much more easy, as the Ceara (Manihot Glaziovi) is a tree easily raised from seeds, and the Assam Rubber (Ficus elastica) is a tree raised either from seeds or cuttings. These two are known, and in cultivation in Natal; the other two now being largely planted elsewhere have not, so far as I am aware, ever yet been successfully raised here, but that does not prohibit the possibility and even probability of their eventual success in Zululand. Concerning all these, after

much investigation, Mr. O. F. Cook, in Bulletin 49, U.S. Department of Agriculture, writes:—

"The preceding paragraphs may serve to explain why no decision has been reached on the very important question of the relative agricultural value of the different rubber-producing trees. It has been supposed thus far that the climatic and cultural requirements of the Para Rubber tree (Hevea) and the Central American Rubber tree (Castilla) were quite different, but the results of the present study seem to indicate that the differences, if any, have been much over-estimated. The comparative experiments thus far carried on in Botanical Gardens have, at most, but a local value, and cannot be accepted as final. In Java, for example, both Castilla and Hevea were condemned in favour of Ficus elastica (Assam Rubber), but it now seems probable that the continuously humid mountainous district in which the experiment was tried was quite unsuited for testing the productive powers of Castilla, and probably of Hevea also. It may be that no one rubber-producing species will attain any great or exclusive preponderance, but that different climatic and soil conditions can best be met by planting different trees. The wisest policy of untried regions will be to make experimental plantings of all the more promising rubber trees. At present these are three in number: Castilla, Hevea, and Ficus. Manihot (Ceara rubber) can probably be omitted from the list, except for regions too dry for the others. . . . Fortunately, however, rubber planting has been confined to the warmer and drier coast plain, and to localities where both wild and planted trees have been found productive. That it will become possible by correct methods to produce rubber in countries where the tree is not native, and even in localities where the wild trees do not yield well, is to be expected, but it can scarcely be repeated too often that the planting of more than experimental quantities under untried conditions is a hazardous enterprise, to say the least, and not to be indulged in except by those who can afford to lose."

Concerning Para Rubber, the following statement, which appears in the Bulletin of the Imperial Institute (September 29th, 1904, page 187), indicates under what conditions it thrives in Ceylon, where its culture has become an extensive industry:—

"It was formerly believed in Ceylon that the Para rubber tree (Hevea brasiliensis) would only flourish upon low-lying land up to an elevation of 500 feet, but this view was quite erroneous, and was not supported by the range of the tree in its natural habitat. Experiments have shown that in Ceylon the tree will thrive and furnish paying quantities of rubber when planted upon hillsides up to 2,700 feet, and it is still undecided whether its cultivation can be successfully undertaken at higher altitudes. It is stated that the tree grows most rapidly at elevations of about 500 feet, but for practical

reasons an elevation of from 1,000 to 1,500 feet is preferred for plantations, as in the latter case the latex flows more freely, especially in the hot weather, whilst the yield of rubber is the same as at the lower altitude. The tree will grow apparently upon very poor soil, though the yield of rubber would probably not be very remunerative under such conditions, and plantations will, of course, always be established on fairly good soil, which should not be too stiff."

Para rubber prefers good drainage on rising ground; in such site it grows naturally to be a very large tree; it is not, however, a swamp tree. Concerning Castilla, Mr. Cross, who collected the seeds in Central America from which plants were afterwards sent to India, says:—

"The Caucho tree grows not in inundated lands or marshes, but in moist undulating or flat situations, often by the banks of streamlets and on hillsides and summits ,where is any loose stone and a little soil. It is adapted for the hottest parts of India, where the temperature does not fall much below 74 deg. F. The tree is of rapid growth, and attains to a great size."

Doubt may be expressed as to whether the temperature is high enough in Zululand for either Para or Central American Rubber, but this can best be decided by local experiment.

There are many other rubber-producing plants, but the above are those most common in cultivation as yet.

Analysis of the rubbers of two Maputaland species, Landolphia Kirkii and Ficus sp. (Mpai), and further information concerning them are to be found in the report of the Conservator of Forests, Natal for 1903-4.

There are many other valuable trees, such as the *Camphor*, Cinnamomum camphora (Fig. 83); The *Sisu*, Dalbergia Sissoo; Erythroxylon coca; *Sal*, Shorea robusta; *Turpentine Tree*, Syncarpia laurifolia; *Swamp Cypress*, Taxodium distychum (Fig. 40); Flindersia australis; *Silky Oak*, Grevillea robusta (Fig. 33); *Courbaril*, Hymenaea courbaril; *Quebracho*, Aspidosperma Quebracho; *Quebracho colorado*, Loxopterygium Lorentzii; *Tamarind*, Tamarindus indica; *Litchi*, Nephelium Litchi (Fig. 81); Terminalia Bellerica, *Myrobolans* (Fig. 54), etc., which are at least worth trial in this region, which contains possibilities in timber and fruit culture not found elsewhere in Natal. Among ornamental trees and shrubs there is also scope for much which is not found meantime outside the Botanic Garden, Durban, and probably many plants will succeed here which have not been unqualified successes there.

Palms especially should form a leading ornamental feature, as the native fan palm, Hyphaene crinita, already does in many places.

CHAPTER XI.

THE BLACK WATTLE INDUSTRY.

(Acacia mollissima.)

Natal is the fortunate possessor, in the culture of Black-wattle, of an industry unique in many respects. Among these may be mentioned:—

(1) Wherever it exists it is the only timber industry giving a full return within a few years, and keeping that up in perpetuity;

(2) It is an industry in a foreign tree whose cultivation in its native land was neglected until the possibilities of the industry were demonstrated in Natal;

(3) Though the industry is only 20 years old, Wattle-bark is one of the most important over-sea exports Natal has, its value having now reached over £70,000 per annum, and is rapidly increasing;

(4) Among timber cultures it is the only one which yields a high rate of interest on capital invested, and that even without expert management;

(5) It has given a high value to certain soils unsuited for ordinary cultivation, and has raised the general land values in the Wattle districts as much as if a town had sprung into existence in the neighbourhood;

(6) It has made steady progress, and there is every prospect that it will continue to do so. At present there are over 30,000 acres in Natal under Black Wattles.

With so many points in its favour, while there is little available literature on the subject, it is not surprising that the enquiries reaching this Office should be so numerous as to call for this article, to save long individual replies. Little can be stated which has not been stated before, but it is hoped that here it will be more accessible to intending planters and others interested in the industry.

History.—Already the history of the introduction of Black-wattle has become somewhat mixed, and there are quite a few claimants for the honour of having been the first to adopt Wattle on a commercial scale. Though it probably arrived at first as an ornamental tree, the writings of the late Baron von Mueller, particularly his "Select Extra-tropical Plants,"

drew attention to its value as a tanin-producer, but at the same time gave it several competitors, since other species of *Acacia* were described as being more hardy, and nearly as productive of tanin. Along with this was the fact that considerable confusion existed in regard to the botanical nomenclature of the various species of *Acacia*. These species were difficult to determine from written descriptions, and the result was that *Acacia dealbata* (Silver-wattle or Blue-wattle) had the first innings, and continued for a good many years to be sown in quantity before the comparative values of the several kinds were ascertained. Now the Black-wattle industry of Natal limits itself to the cultivation of *Acacia mollissima*, though the bark of various other species may occasionally be mixed in small quantity as an adulterant. The proportion of such adulteration is, however, decreasing yearly, since all new plantations are of *A. mollissima*, while on many estates *A. dealbata* is being exterminated, and the use of the latter is now confined to up-country districts, where the conditions do not meet the requirements of *A. mollissima*, and where the bark is not even a secondary consideration, props being the main product, and shelter the first desideratum. *A. mollissima* appears in several varieties, one form being considered much more hardy than the commonest form, and still of high value alike for bark and timber.

The first small plantations appear to have been in the neighbourhood of Camperdown, but they were soon followed by others in the Howick district, as well as on the Noodsberg.

In 1888, Hon. G. M. Sutton, now Prime Minister of Natal, who has been leader in the industry from the start, published a very useful pamphlet on "Wattle Bark, a Paying Industry," in which Australian records, and his personal experiences in Natal, combine to point directions in which intending planters might expect profit. A revised and enlarged edition appeared in 1892, since which date, with the exception of occasional newspaper articles, no important South African literature appeared up till 1902, when Hon. F. T. Angus, M.L.C., another prominent leader in the industry from its inception, contributed an article to the Natal Directory for that year, in which recent improvements in practice are duly recorded, and standard methods described.

Mr. Sutton (now Sir George Sutton) has placed on record that from 1884 onward he sold locally a few tons of bark annually, at from 3s. to 6s. per cwt., and that in 1887 Messrs Angus shipped the first successful consignment from Natal to Europe—about 10 tons, a small consignment in the previous year having cost in charges more than it sold for. From that date shipments have been regular, and though the price fluctuates somewhat, the industry has in recent years taken third place as an export, those ahead of it being wool (which is partly from the Transvaal and Orange River Colony), and sugar.

The exports of Wattle-bark from Natal have been, according to senders' Customs returns:—

			Value.
1886	...	39 packages	£11
1887	...	449 packages	315
1888	...	864 packages	410
1889	...	4,623 packages	2,783
1890	...	7,911 packages	3,389
1891	...	13,972 packages	5,588
1892	...	19,408 packages	9,234
1893	...	22,976 packages	9,304
1894	...	40,485 packages	12,569
1895	...	57,666 packages	17,209
1896	...	3,378 tons...	16,450
1897	...	4,098 tons...	17,659
1898	...	9,427 tons...	30,929
1899	...	11,070 tons...	57,885
1900	...	8,900 tons...	46,479
1901	...	13,771 tons...	69,850
1902	...	15,537 tons...	74,554
1903	...	12,135 tons and 168,767 bags	70,581

Total 167,493 packages up till 1895; 78,316 tons and 168,767 bags during 1896-1903; or, approximately, 100,000 tons altogether; valued at £445,208.

These figures show a tremendous and well maintained expansion, partly the result of a boom which occurred after shipments began to sell in Europe, and partly steady increase since then, which still continues, if it has not again actually reached a boom condition, and which must contiuue when recent planting comes into bearing. Several strong companies have from time to time been formed; the Town Hill Wattle Company, and Messrs. Angus and Co., both old companies, having over 3,000 acres each, more or less in fit condition for felling now, while several newer companies are laying down plantations at the rate of up to 1,000 acres each a year.

The Black-wattle Industry Abroad.—Much of the information at first received from Australia was in some measure misleading as to results through being based on natural forests rather than on artificial plantations. Even now, local records are of much more use to us than those from Australia, since our experiences are in climate and country thoroughly understood by Natal readers, and the methods adopted are such as are known to suit these conditions, while from Australia climate, soil, methods, labour, protection, and all other factors differ from ours to an unknown extent; varying with each locality. Cultivation has, however, been taken up there to a certain extent; and the Australian Colonies are beginning to realise that Natal has left them in the race, so further encouragement to develop Wattle-growing as a local industry there may be expected. But there is something suggestive in

the application which recently appeared asking to be placed in the way of buying 1,000 tons of Natal bark for shipment to Australia.

In Cape Colony the industry has not as yet taken a prominent position, the acreage not exceeding 10,000 or 12,000, though many parts of the Eastern Province and of the Transkei, Pondoland, and Griqualand East are, except on account of distance from railway, as suitable for Wattle culture as Natal. Indeed, in Griqualand East there are already many nice plantations of Black-wattle, and the formation of the Cape-Natal Railway is causing another spurt there.

In the Transvaal a vast development of Wattle-growing is in prospect, the demand for props and fuel there being sufficient to out-balance the longer freight on bark, if satisfactory sites near the timber market are available. Black-wattles grow luxuriantly around Johannesburg and Pretoria, but the price of land is prohibitive, except at some distance out. The mist-belts of the Eastern Transvaal are, on the other hand, almost too remote.

In California some progress has been made, and a report on Wattle culture there has recently been published, but has not yet come to hand. In the South-Eastern States it does not appear to have been taken up.

In the Mediterranean and North Africa only very small beginnings have been made of what may eventually prove a large industry.

Conditions Suitable for Wattle Culture.—There is a wide-spread belief that in Natal almost no selection is required for the site of a Black-wattle plantation. No greater mistake ever occurred. The Black-wattle is certainly not fastidious, and will continue to exist almost anywhere in Natal, but that is a very different matter from being an economic success. There are sites, soils, sub-soils, aspects, climates, and conditions, often difficult to define but quite recognisable, in which the tree does not succeed satisfactorily, while even in the best it shows unaccountable variations in product, which can hardly be foreseen by even the most skilled cultivator. Financial success—the aim of every planter—demands, therefore, not only experienced selection of site, but also the ability to grasp all affecting factors and modify cultural practice in accordance with these. In no work more than in Wattle culture is common sense required, and probably in none other is there such a wide range of methods all attaining success if reasonably adapted to the surrounding conditions. Indeed, very few growers are altogether alike in their practice, and very few are altogether unsuccessful.

The first requirement is a reasonable supply of fresh moisture. A rainfall of 30 to 40 inches per annum is most suitable; a rainfall of even 20 inches will do if the soil is deep and porous; but while a continuously misty atmosphere is very favourable, the rainfall itself is immaterial if moisture is otherwise available, as around a spring or along the course of a river. On the other hand, it must be fresh and active moisture, as stagnant moisture is very injurious, especially during the first years before the trees have attained full transpiring power, for it must be remembered that a plantation of mature Black-wattle transpires regularly an amount of moisture equal to about 40 inches of rainfall under the ordinary temperatures of Natal Midlands, consequently, if the supply of moisture from all sources is less than that, the plantation will eventually dry out the ground and suffer; whereas if the supply is too heavy, the trees become lichen-clad to an undesirable extent and otherwise suffer, though this seldom happens. It is on account of its absorptive powers that the Black-wattle can, like Blue Gum (*Euc. globulus*), be used for drying up swamps, and although it requires more care than Blue Gum at the start, it is quite as effective in its action afterwards; indeed, so absorptive is it and so wide-spreading its roots, that few trees survive intermixed with Black-wattle except the rainfall is heavy, or the soil very deep.

Rainfall alone is not, however, enough to secure a good crop, there must also be a suitable soil, porous enough to receive the rain as it falls and to give it up as required. The physical condition of the soil is of much more importance than its chemical composition. Mueller's writings have seriously misled many in this matter. For instance, "This tree is to be recommended for poor land, affected with sorrel"; "Any bare, sterile, unutilised place might remuneratively be sown with this Acacia-wattle"; and "It is content with the poorest and driest soil, although in more fertile ground it shows greater celerity of growth." Now, it is quite true that poverty of soil does not alone affect it seriously, soil too poor to grow mealies or even oats is the very land selected by the best judges as the soil for Black-wattle, and the Black-wattle itself responds freely to such selection, but only if the mechanical condition is right, and millions of acres in South Africa answering Mueller's descriptions quoted above are quite useless for Wattle culture through not having correct mechanical condition. Not only is that so, but many hundred acres of Wattles now standing in Natal are on soil in which that condition is not satisfactory, and disappointment or loss will eventually occur in not a few instances.

On this subject I had occasion, in my annual report for 1895 to bring under notice the difference between 5 year old

representative samples cut from the same compartment in Fort Cunyngham plantation as follows:—

Sample.	Height.	Girth at 5 feet.	Weight of bark (fresh).	Weight of wood (fresh) exclusive of small branch-wood.
No. 1, from alluvial bottom land 12 feet deep ...	40 feet	18½ inches	30½ lbs.	177 lbs.
No. 2, from slopes above No. 1. Soil 2-3 feet deep, overlying rock	35 feet	10 inches	8 lbs.	44 lbs.

This was supplemented by these comments:—

"Soil alone accounts for this difference, which would have been much greater in another year, or thereby, as both these trees had still what Mr. G. M. Sutton calls the 'baby stage' of the bark, while by that time the larger specimen would begin to change into the much heavier rough bark. Maiden's Wattles and Wattle Barks begins thus:—'No one who has troubled to make the observation can fail to notice how Wattles frequently flourish naturally on the poorest soil, and thus it is that land can be utilised in this industry where it can scarcely be put under any other cultivation, and where not even grass grows. At the same time bark richer in tannic acid and maturing earlier may be obtained from trees growing on richer soil.'

"The same idea concerning the possibility of reaping a profitable Wattle crop from the poorest of soils runs through almost all writings on the subject, while at the same time examples quoted of what has been done, or what can be done, and what also is necessary to make the industry so remunerative as it is claimed to be, are equal or superior to the better result given above. While the above measurements do not demonstrate whether or not Wattle cultivation on ground such as that used for sample No. 2 may not eventually be a profitable business, they show clearly that when one goes to the expense of preparing, cultivating and reaping a Wattle crop, it will pay much better to use the very best soil he has than to trust to the theoretical profit on Wattles where nothing else will grow. Especially is this the case if the statement regarding the comparative richness in tannic acid of bark from better soil be borne out by further experiment."

I would now add to the above that the best soil for Wattle-culture is not necessarily the best for agricultural crops—indeed, often is not so—but still maintain that selection of soil suitable as to mechanical condition, whether or not fit for cereals, is the most important step in Wattle-culture. The

most suitable soil is the deep red or chocolate soil, resulting from the decomposition of igneous rock, considered by the farmer poor, but deep and porous, never saturated and never entirely dry. Such soil is frequent throughout Natal, particularly on the Eastern slopes of the midland uplands; it is not difficult to work nor to keep clean, and is usually destitute of rock, except occasional doleritic boulders. Next comes deep alluvial black soil, though that often occurs where frost has to be reckoned with. Then the light sandy soil overlying shale, which soil, where sufficiently deep and moist, is very suitable, but is too often trusted where shallow, with the result that trees are small, and become bark-bound and scraggy whenever a dry spell occurs. The shale itself is always to be regarded with suspicion, and the further it is away the better will the Wattles do. But even worse than that is the metamorphic sandstone which forms the bedrock of many riverbeds and streams, and which should be avoided except there be a very considerable depth of soil above. Cold clay is also to be avoided. Open sandstone at some depth is not objectionable.

Altitude and temperature have, in themselves, less influence than is usually supposed, although the obtainable extremes of both are undoubtedly inimical. At farms over 5,000 feet altitude, in the neighbourhoods of Nottingham Road and Mooi River, there are Black-wattles nearly as good as any in the Colony, and in Polela and Griqualand East there are good plantations at an equal altitude, though above that altitude bleakness usually has an injurious effect which altitude alone does not have. On the coast, however, Black-wattles are usually not satisfactory, and their cultivation on an extensive scale cannot be recommended there except in a few favoured localities. The extension of Wattle-culture coastward in Alfred County should proceed cautiously, though some of the finest Wattle-trees I have seen were within three miles of the coast in East Pondoland, and on poor sand overlying sandstone, like some of the plantations on the Murchison Flats.

It is noticeable that Black-wattle is not included in the list of plants cultivated in the Durban Botanic Garden, that grand centre in which almost all present and probable industry-plants of Natal may be studied, and it is quite likely that if its introduction had first been to there an adverse verdict would have been given against it, but this is only a proof of the necessity of test plantations, or experimental economic gardens at various centres throughout the Colony.

Generally speaking, the good Wattle country in Natal corresponds pretty closely with the Yellow-wood belt, including suitable areas over 15 and under 70 miles from the sea, right through Natal and Zululand, with occasional outlying arms along the foothills of the Drakensberg, but not including any part of what is known as "thorn-veldt," in which class of country Wattle-culture is usually doubtful. There is thus

excluded, besides the coast belt, the whole valley of the Tugela, the bed of the Umkomaas, and much of the Umfolosi, localities too hot and dry, and otherwise unsuitable for Wattle-culture. In the Tugela valley many alluvial valleys and occasional high builts will carry the crop, but the climatic conditions are there such as to limit the possible stripping season to the very few weeks when other work is all on hand. In Ixopo and Harding Districts much planting may be expected as soon as a railway is assured, while in Zululand, the Nkandhla, Eshowe, and Melmoth Districts are mostly as suitable as the Noodsberg, though as yet too inaccessible.

Considerations In Starting a Plantation.—Among these may be mentioned:—

(1) The conditions suitable for Wattle-culture which have been discussed above.

(2) Proximity to Market.—This applies not only to bark but to timber also, for it must be remembered that on some estates the timber has a value equal or greater than the bark, while on others it does not pay to move the timber after it is stripped, and it consequently remains to rot, enriching the soil, but also being a source of danger through its liability to breed fungus spores, which may eventually cause trouble in the succession crop. At present there is stagnation in the wattlewood market, but that is temporary, and some reliance may be placed for years in an up-country demand for mining props and a local demand for fuel, the latter fluctuating considerably in accordance with the state of the weather and the general condition of farm work at the time. During recent years fuel has usually been killed by cartage charges if situated beyond 8 or 10 miles from the railway, while heavy mine timber could stand twice that cartage, but in either case the profit is reduced if much cartage has to be done.

(3) Cost of Land.—The planter has really to consider whether he can best pay a high price for land in proximity to market, or a low price for land where cartage costs a good deal. In the latter case, however, labour is usually obtainable and reasonable, but, on the other hand, timber is not easily marketed.

In some Wattle districts the purchase price of land has gone up to about six pounds per acre, whether wattle land or grazing land. In other districts good wattle land is obtainable at 20s. per acre, but is without road or railway, and may remain so for some time.

(4) Economic Farming.—A large block can be more profitably worked in every respect than a small one. Fencing, management, labour, etc., all cost less per acre. But, again, while the cost of all these is the same on an unsuitable or only partly suitable farm as on a first-rate one, the financial results are very different, hence the great advantage of thorough selection before work is commenced.

A large wattle plantation is quite enough to occupy an energetic manager's whole time and attention, but a certain amount of agricultural produce may sometimes be also reaped during the earlier years. Thus, for instance, on grain producing farms a crop of mealies sufficient to meet the whole expense of laying down the crop, including the wattle crop, may be reaped, while on other farms an attempt to do so would certainly result in dead loss.

Again, a farm which can be easily worked is preferable to a difficult one, all other things being equal, but it is bad economy to start on dirty old Kafir lands rather than break up fresh.

Preparation for Sowing.—The first consideration is how best to avoid future weeding by getting the Wattle crop up before the weeds. Old lands are seeded with weeds, new lands if badly handled get under weeds almost immediately, while if properly handled they should always remain clear of weeds, the wattles taking possession before the weeds start. There is, therefore, money saved by proceeding correctly at this stage, not only in having no cultivation to do until the trees take possession, and in avoiding the danger of fire, but even after the first rotation is over grass-weeds again take possession if they have not been killed out at first, and often cause much trouble then when cultivation is less practicable.

If old lands must be used, the best way is to take a crop of early mealies, cultivate that well during the season, reap it as early as possible, and at once plough and sow with wattles. These wattle germinate within a week or two, and are ready to get into active growth in spring, having a start over the summer weeds, which start they keep up, especially if the wattles are sown rather thickly. Annual weeds do not really do much damage so long as the wattle has its head above them, but if the wattles are sown in spring the summer weeds generally get ahead and dominate them, while where it is present the *Mkanga* weed (Senecio juniperina) usually gets strong towards winter and dominates the wattles during the next summer.

In new land the annual and biennial weeds are usually not so troublesome as the grass remaining from the former grass-veldt. Numerous methods are adopted to prevent any remaining. The surest method is to postpone ploughing till late in the summer, burn off the grass, and plough not more

than four inches deep, either completing the sowing at once if not too near winter, or leaving the turf to rot till spring before doing anything further. The advantage of the rather shallow ploughing is that the grass roots are almost entirely in the turned sod, and during the dry winter die out entirely. But it has a disadvantage also if sowing is done at once, since the depth of cultivated soil is small, and it is disconnected from what underlies it. The more usual method is after having so ploughed late in summer to cross plough more deeply in spring and break down to a fine surface before sowing. But in this the nature of the ground must be taken into consideration, for some soils work with difficulty until rains begin, and others are more difficult to work when wet. The first ploughing should be thorough, and not performed until the grass is fit to burn, otherwise the vigour in the grass roots, combined with the rains of that season, start grass-growth again instead of killing it. Any plough answers the purpose if well held; the rough ploughing of the disc-ploughs does as well as any if performed in autumn and cross-ploughed in spring. For cross-ploughing the disc-ploughs answer well, and give little trouble in harrowing. Subsoil ploughing may in some soils be advisable, especially where the subsoil is rather stiff, but generally speaking soils which require this preparation are not the most promising. The action of the subsoil plough, or deep cultivator, is however, to break the subsoil without lifting it, and the result is that the soil receives more water during rain, without being saturated, and then gives it off to the trees gradually as required. No more grass-veldt should be burned at a time than can be ploughed before its gets green again, fire lines having previously been prepared to prevent undue spreading of fire. On light soils all that is wanted after cross-ploughing is a turn of the light harrows, but on stiff soils the use of the disc-cultivators, clod-crushers, and other appliances is necessary before the proper tilth is attained.

Before sowing can be done the soil must be ready and the seed also prepared. This preparation of the seed is a special process not in common use for other kinds of seeds, and used only with regard to a few kinds, mostly luguminous, which become so hard that, sown in the ordinary course they may lie in the ground for months or years before germination takes place. They are accustomed in their native habitats to germinate only after the seed-shell has been burst by scorching in a forest fire or grass fire; by evolution this has become part of their nature; and now either scorching or some equivalent process is found necessary if rapid germination is to be effected. Scorching is found to be a difficult process to regulate satisfactorily in artificial work; either it is over-done or underdone, or the process is so slow as to make it expensive. But an easy equivalent is the soaking of the seed in boiling water whereby the coat is softened and the germ started into action. I find in practice that the best method is to half-fill a five

gallon tin of Wattle-seed and pour boiling water over it until the tin is full; then leave this to cool gradually and to soak into the seed for 12 to 24 hours, by which time the water will have disappeared, and the seeds will have swollen to nearly fill the tin. But seeds of different ages require different treatment; freshly gathered seeds will be quite prepared by the above treatment; seeds a year old may be better left two days in the tin to soak, while older seed is better to have boiling water again poured over it after it has stood a day and to be left again to soak, while very old seed occasionally requires even a third treatment.

The proper condition for sowing is when the seed is soft enough to be cut in two without trouble by the thumbnail pressing against the first finger. Until that condition is reached continue soaking; there is no danger of overdoing the application of boiling water, and some growers even allow the tin to simmer for a time over the fire. There is, however, a danger of overdoing the soaking afterwards, as when once the germ has sprouted it develops rapidly, and gets into a condition so active that it suffers readily if by accident it is dried off again during the process of sowing or afterwards. Seeds of various ages should on no account be mixed, as in that case some get ready long before others, and if the last are ready the first are in danger of drying off. Seeds sufficiently soaked germinate in about two weeks; seeds insufficiently soaked continue to germinate irregularly for two or more years.

By the time the seed is sufficiently soaked there is often produced among it a mass of muscillaginous jelly, which renders the whole boiling difficult to sow; indeed, it is always too wet and cohesive to sow without further preparation, which consists either in washing the seed through several waters, or in mixing the seeds with fine dry sand to whatever extent is necessary for the sand to absorb all the superfluous moisture and jelly, and render regular sowing either by hand or by machine practicable.

It must be carefully noted, however, that after germination has once been started by the above process it must be allowed to continue; the seeds must be sown at once after being washed or mixed with dry sand, and then covered with soil without delay. If the seeds after soaking are left exposed to dry wind for a day, the germ runs a risk of being killed; if sown in ground too dry to maintain germination the same danger occurs, and if held over in the tin or bag for a few days after being germinated it is apt to heat and sprout very rapidly, and become too tender for sowing. More blanks occur, however, through insufficient soaking than from all other causes.

The seed being prepared as above and the land ready, sowing may be proceeded with, either broadcast, or in lines by hand, or by drill machine. The most common practice is in lines by hand, machines being seldom used, while broad-

casting is by most growers considered too irregular in its result, besides requiring a thinning, which costs more than the additional labour connected with sowing in lines.

My experience is that where close planting is practised, no other crop taken along with it and the soil is not apt to get dirty, broadcost sowing on a freshly ploughed or harrowed surface, followed by a light harrowing, secures the best germination, and is as good a system as any, especially in autumn, and should be followed by a light thinning in early summer. This, however, implies that the trees will always stand irregularly on the ground, unless thinning into lines is practised afterwards. Lines are orderly and systematic, and probably assist sometimes in the regulation of task-labour in the harvesting, but for actual growth they do not possess any special advantage, while irregular broadcasting costs less and has fewer blanks. The practice in Natal is, however, orderly lines, which are neat and business-like, and give the whole industry an air of skilled labour, or rather, of skilled management, which is awanting in broadcast work. Where no mealie crop is taken the lines are usually arranged by placing stakes in line at short distances so that several are in sight at once; a coolie then proceeds from one stake to the next, keeping the line of stakes in sight, and with a hoe prepares small seedbeds in slight depressions at the determined distance apart, which ranges from one to three paces. Another coolie follows and drops about a dozen seeds into each seedbed, covering them lightly with his foot. The guide-stakes are then moved forward to be ready for the next line, or several coolies may work abreast with two men on each line. The danger is that the seed may be buried too deep. Mr. Angus states concerning this method:—"With ten men and two attendants, 30 acres per day may be sown at six feet apart, more or less, according to the state of the soil, as if this be dry or badly worked, much delay is caused by the necessity for making a fine seedbed by hoeing." Such sowing is usually done during early summer, say, October to January, and belongs more particularly to the poor red soil on which mealies fail. Where mealies succeed it is usual to sow the mealie crop in lines, 3, 4, or 5 feet apart, and after the first or second hoeing or cultivation to introduce a line of Wattles either between each pair of rows, or leaving one or two blank lines between each row of Wattles. Such sowing is usually done by two coolies after the fashion described above, though sometimes a light plough furrow is cast between the mealie lines, into which the seeds are dropped and lightly covered. Or, in some cases, the mealies and Wattle-seed are sown at the same time into separate lines taken out by the plough, and then all lightly covered at once by the harrow. In such practice, however, there is danger of too deep sowing, as the seed should be only just covered. An article in the "Agricultural Journal" recently recommended sowing several inches deep, with a view to keeping the seed

until suitable weather arrived. It is possible that in certain soils and conditions of the weather such sowing is of use, but I recommend caution in its use until further tried. The whole area should be gone over again six or eight weeks afterwards, and fresh sowing done wherever blanks occur, for it is very important indeed that the whole crop be both equi-distant and of equal age. A gap filled by seed a year after the original sowing produces a plant which is dominated throughout its career, and seldom attains maturity; a blank left unfilled causes the neighbouring trees to branch unduly, and produces difficulty in stripping, while filling blanks by transplants from tins is both costly and seldom satisfactory.

The amount of seed to be sown varies with the ground and the method of sowing. The less seed used, so long as there is a sufficient crop, the less labour will there be in thinning; but it must be remembered that it is much easier to thin out than to fill in after the crop has germinated. In general practice, sowing in lines, one to one and a half pounds of seed is used per acre, but for broadcast work considerably more is required—up to five pounds. On dry or lumpy ground more seed is required than where the seed-bed is fine, and so also where sowing is done on freshly broken up ground without much preparation.

Thinning should be done as soon as the seedlings are fit to handle easily, say, when six to twelve inches high, and is best performed by hand, as in hoeing many plants start again from below if cut near the crown. If locusts are about, or likely to be about, it is better to leave too many plants than to thin to the exact crop.

Distance Apart.—On this point opinions and practice vary more than on any other; no definite rule can be laid down since soils differ indescribably in their power to carry a crop; and common sense must be exercised with regard to every farm, and every acre on that farm.

Where trees grow rapidly into tall straight boles, as in deep red soil or deep alluvial land, there is a corresponding amount of foliage produced which requires wide espacement—say from six to ten feet apart each way—before maturity is reached. But the nature of the tree is to branch freely, and make less height if it has sufficient room, consequently that espacement is too wide at first, and sowing on such land should be done either twice or four times as close as the final espacement, thinning being practised afterwards as found necessary.

On soil which only makes small wattles at the best, it is necessary to sow more closely, not because such land can produce more trees per acre than the other, but because if thinned to, say, ten feet at an early stage, short heavily-branched trees would be produced, on which much of the bark would have to come from small branches, and the logs would be knotty and of low value. It is preferable, therefore, to be content with smaller but cleaner stems and have more of them,

the final espacement being not more than six feet, but rather under that figure.

Thinning.—The golden rule in thinning is to always leave enough trees to maintain canopy, without leaving enough to seriously injure girth growth. Here again common sense is the only safe guide. Thinning at three or four years may sometimes be necessary when the thinnings do not pay the cost of extraction; in other cases, if the espacement is reasonable thinning may never be required. Some growers intentionally sow close and thin at three or four years, others intentionally sow sparsely, and do not thin until the bark is worth stripping. All depends on the circumstances of soil, weather, labour, etc., and these give scope for the ability and resourcefulness of the individual planter. Often the thinning and felling processes dovetail into one another, and this subject will be further treated in connection with felling.

Pruning.—It has not until recent years been considered necessary to prune Wattle trees, or rather, it has only been necessary when something was wrong with the espacement. But the industry includes among its workers many close observers and thinkers, and the advantage of regular pruning has not escaped notice. To Messrs. Angus and Co. belongs the credit of having introduced this improvement in practice which is rapidly being taken up by others. The underlying principles are (1) that a single clean stem is worth much more than a forked one, and (2) that an equal crop is worth more than one in which a few dominating trees have to make up for the weakness of the injured trees surrounding them. In all plantations it will be noticed that scattered trees during the first year get far ahead of their neighbours, and if allowed to go on they eventually dominate them, to the injury of the crop. Messrs. Angus and Co.'s method is when the trees are one to two years old to have them gone over by trained coolies who examine each tree, removing forks, stopping unduly strong laterals, and stopping back the leader where that is necessary to secure uniformity throughout. A compartment in their estate recently examined by me reminded me of nothing so much as a well pruned orchard, every tree having been examined and unsparingly handled where that was necessary. The result in compartments some months pruned was a perfectly level surface of equal sized trees, while in compartments a year or two pruned the same equality remained, showing an undoubted advantage over unpruned sections. The labour incurred, though performed by coolies, is of a skilled nature, and requires some time, but I am satisfied that the operation is highly profitable, and the most progressive move the industry has ever made. Pruning is probably more remunerative on regrowth, where the growth is somewhat irregular, than on first sowing, but should be practised on both. Fig. 68 shows the practice adopted.

Roads.—The practice of laying out a plantation into compartments separated by roads has its disadvantages as well as its advantages. Such roads invariably grow grass, and are a source of danger from fire or else an expense to keep clean, while there is no reason why the ground should not be in crop like the rest until thinning is necessary or felling begins, and then be the first lines cleared. Particularly is this the case where trams are used for the removal of produce, and no great space is required either for roadway or for turning of wagons. If the ground was correctly prepared at first there should be no danger whatever from fire, but even if there is, a few lines are as easily kept clean under the trees as in a roadway. In Wattle growing more than in any other class of timber culture, large compartments separated by natural boundaries such as streams or ridges are practicable and profitable, the roads being only laid out with the level and cut off when required. On all large estates every road should be graded fit for tramway use, whether tramways are laid down at first or not, for the saving in stock and labour thereby effected must eventually lead all extensive growers into the use of trams, both for timber and bark, while the convenience of the tram service in securing bark in showery weather must not be overlooked. Roads through swamps or wet places are easily made passable in all weathers by the use of Wattle poles laid parallel across the track, and it is found that even young poles last well in such a position.

Felling.—Thinning of any material over three inches in diameter must be considered a first felling, and should yield bark to do more than pay the expense of the thinning, though such bark costs more to strip, per ton, than mature material.

As maturity is reached felling may be either a clean cut, or taken gradually over several years. On deep soil the latter method is usually practised; on shallow soil, or soil that grows small Wattles, nothing is gained by thinning towards maturity, except in those unsatisfactory plantations where barking can only occasionally be done, and where each tree must be taken when it is workable (*i.e.*, when the sap is up), and the others left till the next favourable opportunity.

The age at which economic maturity is reached varies immensely. On plantations bearing small Wattles, the main growth is usually made during two or three wet seasons, and if these occur during the first six or seven years of growth there is little advantage gained in waiting longer before barking is taken in hand, as in such a plantation a dry season is a bark-bound one, when practically no increment is made, and a plantation may even lose value through delay in harvesting. Such a plantation cannot, under any circumstances, attain the size or product of a better placed one, and it is useless waiting in expectation of that. Even thinning (towards maturity) is bad practice in such a plantation, as it admits sunlight and produces scorched stems, without introducing increment except a wet season chance to come on.

But in vigorous plantations the case is altogether different. If widely placed, thinning may not be necessary until about five or six years of age, but by that time thinning either by selection of the more advanced or by regular order is advisable. The practice of the Town Hill Wattle Company—whose work throughout shows the most thorough and careful adaptation of practice to surrounding circumstances—has been in some of its best sections to remove at first every fourth line, followed one or two years afterwards by the removal of the middle line of the remaining three, and again followed by complete clearance one or two years afterwards. The manner in which the liberated trees respond there to this treatment, even during dry years, is simply marvellous, close canopy being recovered and girth added even within a few months, but the same cannot be relied upon on every estate, and every factor must be studied in deciding the course of action on any particular spot. In some plantations, through exigencies of labour, weather, war, rinderpest, etc., compartments fifteen years old are still standing, without having suffered from age, though it is doubtful if there has been an economic increment on these during the past few years.

In felling, the axe is the most common weapon, though occasionally the saw is used. On many estates task work is practised, each coolie felling his trees, stripping them, and hanging up the bark at the rate of 1,000 lbs. green bark per day. Some men easily exceed this, and can then earn more days per month than the month contains, others can never come up to the standard, and earn less than full time. Coolies are the best hands at this work, though natives also make good time, and can employ their wives and children in the barking process. Some Italians, introduced some years ago, scoffed at first at the Coolies task, but soon found they could not produce it, even by practice.

The coolie, having his task to produce, adopts whatever method he chooses; most ring the tree near the ground, and pull the bark down to the ground and as far up as they can—say, 20 or 30 feet if it is rising freely—while the tree stands; others ring the tree as far up as they can and pull downward to the ground, completing the process after felling; if the bark rises badly it is often necessary to do a certain amount of hammering before the bark will peel, though this is bad practise in every way. Branches down to about two inches in diameter are peeled, and the bark into the ground should always be taken.

Where the timber is of value, felling should be done not more than nine inches above the ground; where it has little value, it is common practice to fell where it is convenient to use the axe, say, two or three feet above ground; and hundreds of acres are to be seen set with such stumps and littered with trunks which have been left to rot after being barked—a lamentable sight of produce necessarily wasted through dis-

tance from market, and which must continue until railways (even light railways) are closer placed, or some industry of wood-pulping, wood-distillation, or turning into smallware, can reduce the bulk and increase the value of the product now going to waste, except for its value in the production of humus.

Drying.—On the care with which this is performed depends the market value of the product. The peeled side of the bark should never get wet, nor should it be exposed to sunshine, or come in contact with iron, which blackens it, producing ink. It is not, however, the rain itself which is deleterious; a summer shower may pass over partly dried bark without injury if followed by bright or windy weather, but it is the continuance of close, heavy, rainy, or misty weather which spoils the colour and induces mildew. To overcome this many processes are in use, but there is still room for the inventor, as none are quite satisfactory. The best is to secure a farm where barking can be carried on all the year round, thereby completing such work during dry weather, and leaving it alone or working only manageable quantity during the rainy or misty months. By such treatment the cost of drying sheds is saved, the drying is all done in the open, which is the most satisfactory method when practicable, and the danger of bad colour and mildew is practically averted.

In small plantations it is usual to spread the bark, green side uppermost, on the branches and twigs of the felled trees, or on older branch-wood if such be available, and to leave it there till it is dry. In larger plantations it is usual to tie light trees horizontally to others still standing, at a height of about five feet above ground, the ties being made with strips of wattle bark. Upon these the coolies hang their bark as stripped, so that even at the end of the first day it has dried sufficiently to make it more portable, the day's task in that case being often by a method of measurement as it hangs rather than by actual weighing. If the weather is fine it is left there for several days, or until dry, but if rain may be expected it is usual to move it to the drying sheds and put it under cover, hung up again as close as it can be hung without actual contact. While this exempts the bark from danger of rain it does not clear it from danger of mildew, which, in a closely packed shed and during continuous wet weather, is sometimes very great. Movable roofs have been tried, and pronounced cumbersome, and perhaps the most satisfactory method so far is that adopted by the Town Hill Wattle Company and several other growers, of having the drying sheds open at one side and with elevated rails as runners extending the width of the shed and also a much greater distance outside, every pair of rails, 8 or 10 feet apart, forming a gangway on which light poles carrying the bark rest, these poles being connected at two-feet distance by a chain on each side, which passing over a pulley and into gear at the end of the gangway, may be drawn with their attached poles and loads of bark out into the

open air as soon as weather is propitious, and back again into the shed as soon as necessary.

Fig. 60 shows Messrs. Angus's drying sheds at Ravensworth, and Fig. 61 those of Messrs. Holley Bros.'s sheds, where outside as well as inside framework is erected, but where the removal is done by hand, and consequently is much more laborious than that described above, of which Fig. 67 gives a sketch showing the first platform occupied by bark drawn out into the open air, the second occupied by the empty poles, while in the others both bark and poles are indoors, and Fig. 67a shows the chain, having ring-links at regular distances into which the poles can be slipped.

Wagon sails are frequently used to cover half-dry material lying where barked, and are good for a few hours rain, but very close and apt to induce mildew if used for several days continuous rain, as the weight of the sail presses the bark into a damp, close mass. I have not seen, but would suggest that where the bark is hung on horizontal runners suspended to standing trees, it might be worth while to erect on poles other parallel runners, say two feet distant from one another, and then another runner from tree to tree, several feet above the first lot of bark, and to use one or two wagon sails over the upper runner and extended outward, tent fashion, above and clear of the bark, on tight ropes, as an inexpensive, portable, and efficient temporary shed.

Wattle poles form most of the drying plant, and are obtainable as soon as stripping commences, though dry poles are lighter and more easily handled. From one to two weeks is the time necessary for drying; if the weather does not allow it to be dried in that time there is little hope of making it good bark, though some growers do then chop and further dry it by continued turning. After being sufficiently dried the bark may be stored in bulk, or immediately converted into chopped or ground material ready for shipment.

Preparation for Shipment.—Many growers bundle their bark and sell it without further preparation to those who are prepared to undertake that duty and arrange shipment. Little or no bark is, however, shipped in bundles, almost all undergoing the processes of chopping, shredding, and grinding, or one or more of these. The machines in use are by various makers, and most of them differ from one another; they all require steam power, and produce a product chopped into inch pieces or less.

Concerning the packing, Mr. Angus writes:—"Three men will pack seven tons a day. One man fills the bag, another stamps the bark into it, and a third sews up the bag. Each man filling, stamping, and sewing alternately. We have tried several plans of packing by machinery, but none are so satisfactory as hand packing. If the bark be from young trees and very light, seven tons is too much for a day's work."

I have not seen any machine so satisfactory as hand packing with the use of an iron ram, though several expensive machines are being offered, and as freight is by weight, not by bulk, slight difference in the amount packed per bag is immaterial. The packing frame is either sunk into the floor of the shed or stands separate from it, but adjoining, and at a lower level, so that the bark can be shovelled downward into the bag, the mouth of which is held open by several hooks. Three bushel (muid) sacks are in general use, but the material is sold by weight, which varies per bag in accordance with the age and quality of the bark. In 1902, 189,060 bags shipped weighed 15,537tons, or, say, 184 lbs. per bag.

Shipment.—This is usually done through an agent, Messrs. Angus and Co. and Mr. von Bulow doing most of the agency in the Noodsberg District, while various Pietermaritzburg and Durban firms collect elsewhere. The cost of transport of bark from Noodsberg to Durban is about 6s. per ton, and from Durban to Europe 20s. per ton, though notice was lately given that the rate would soon be increased to 30s. Such increase in the freight is very ill-timed, just when Australia realises her lost position in the industry, and it may drive fresh energy and capital rather to Australia than Natal, if persisted in. A Committee of the Farmers' Congress, representative of the Wattle-growing interest, however, took the matter up vigorously, and secured a present rate of 25s. per ton, but for no fixed period.

Timber.—The timber of Black-wattle has not thus far been much used for technical purposes. It is hard, close grained, and fairly heavy, with a tendency to split, especially when felled during summer, as it usually is. No better fuel exists, and all the lighter material within reach of the market goes for that purpose, while the heavier goes into mining work. The General Manager of Railways has supplied the information that during the six months ending 31st December, 1902, 2,020,276 lbs. of mine props were carried as local traffic, and 1,142,280 lbs. as through traffic. As fencing poles Wattle has a life of six or eight years, unless charred or tarred, which makes it more durable, but the fence must be bored or hung by wires, as staples cannot be satisfactorily driven into the Wattle. If staples are used the two points should not be placed above one another, or splitting of the pole ensues, and the staple becomes slack. Excellent gates are made by Messrs. Angus and Co. and others from its timber; poles come in useful for many rough farm purposes and Native hut erection, and even dressed doors and door-frames, tables, and other pieces of furniture have been shown, but no lively industry in these has developed.

Regrowth.—In most other industries once a crop is taken off, a repetition of the original expenditure is required before a fresh crop can be started; in Wattle-culture, however, the regrowth comes naturally in such profusion that the expendi-

ture necessary is on purpose to thin it down and regulate it. The Wattle is not a good shade-bearer, and if young trees germinate under their parents they usually die off at an early stage; even after half the original crop has been removed this remains so, but as soon as the final clearing is effected seedlings come up in profusion even without turning over the ground, which, on account of stumps and roots is often impracticable. Some growers, on purpose to obtain neat work, have burned off the refuse remaining from the previous crop—branches, logs, twigs, foliage, seeds-pods, etc., but it has been found that such burning has the effect of scorching the seeds, and producing too plentiful a crop of seedlings, and the practice has consequently had to be abandoned. Even without scorching there are usually so many seedlings that considerable expenditure is required to thin them out sufficiently. Usual practise is when the trees are 6 to 12 inches high to remove all except a line midway between the old stumps, and to thin that to the desired distance. In this way lines are again secured without much trouble. If the ploughing and preparation for the first crop were sufficient to kill down all weeds at that time no further trouble from grass-weeds may now be anticipated, but if the first crop had to struggle through grass in its earlier stages, the same or a worse condition even may be now anticipated, and should be prevented by thinning and hoeing before the weeds resume complete possesion. If the ground is very dirty the surface should be burned, and the space between the stumps ploughed with a disc plough, before germination commences. Pruning should come in early so as to secure uniformity throughout, and if any blanks exist let them be filled up during the first season or it is useless to do so afterwards.

The second crop, if thinned sufficiently, matures in about the same time as the first crop, and so far as is at present known succession crops may be expected in perpetuity, as each crop leaves the ground more rich in humus than its predecessor. A crop of Wattles also leaves the ground more fit for carrying a cereal crop than it formerly was, though the difficulty of keeping it clear of Wattle is at first immense.

The Wattle coppices more or less from the stumps left after felling, and the growth from these coppices is more rapid at first than that of seedlings; but as the coppice shoots sit on the side or edge of the stump they are apt to be blown off, and very few Wattle growers allow them to make a start, preferring to kill them off as soon as they show, and have an equal seedling crop instead.

In regrowth, as well as in first sowing, considerable difficulty is sometimes experienced from frost. It is curious that a degree of frost which is frequently experienced without injury among exposed up-country wattles, kills areas clean out during their first and second winter in lower valleys. The action is most erratic, and suggests that frost-holes have been

formed in the atmosphere, which can only be prevented by leaving a few of the previous crop standing scattered until the regrowth is beyond danger, while on first crop, where this is experienced, I suggest sowing early in lines, afterwards sowing in between the lines a crop of late mealies (by the use of phosphate if necessary), and leaving the mealies undamaged as a shelter through the first winter.

The seedling wattle lies flat on the ground during its first season of growth, and is seldom damaged by frost when in that condition; if, however, it shoots upward when young that shoot is more liable to frost-bite than the flat growth, and even during the second winter there is a danger if the point is not above the frost line. Hence arises the necessity of sowing in frosty localities at such season as will have a fully mature flat growth without any upright growth during the first winter, so as to secure the best possible growth during the next season, and get the point beyond the frost line. Deep cultivation before sowing, and surface cultivation during growth will also assist to secure this condition.

Seed Collection.—This is performed by native boys and girls, with hooked sticks, climbing the trees and breaking the bunches of seed-pods into baskets or tins just before the seed is ready to fall. The seed is afterwards liberated by threshing, or exposure of the pods to bright sunshine, and cleaned by sifting. Sometimes a very hot day brings a heavy fall of clean seed from the trees, and if the ground underneath is clean and hard the seed may be swept up and sifted at little cost. The current price of seed in Natal is unduly high, *i.e.*, it is out of proportion to the cost of collection, so it pays intending growers on a large scale to purchase trees in seed and collect it themselves. Much seed can be collected cheaply by felling trees when seed is mature and collecting from them; this is probably the best practise, as the seed is from erect, clean stems, whereas otherwise seed collected by climbing is usually from low-branched trees which may have a hereditary tendency in favourable circumstances to reproduce that habit. Seed of the most hardy variety from upland districts should be used in these same or higher districts, as acclimatization is too important to be overlooked in localities which are on the upper border of the natural Black-wattle zone. So also seed from thorn-veldt are to be preferred for sowings in that class of country.

Pests.—This subject belongs to the Entomologist, and will not be entered on here further than to mention that Wattles are not, by any means, clear of insect pests. These mostly act by defoliation, and include grasshoppers, locusts, bag-worm, the caterpillars of one or more large moths, chafer beetles, etc., while in some coastward districts white ants (*Termites*) interfere seriously with the roots and crown, and where health is bad scale occasionally causes further injury.

The bag-worm and the chafer beetles are treated of in the first report of the Government Entomologist, 1899-1900.

Hail also does occasional severe damage; drought often does so; hares, bucks, and trespass stock frequently do a certain amount, and in the Transkei a boring beetle showed some years ago an inclination to take to Black-wattle as a host. In occasional places along the Berg snow sometimes breaks down crowns, but that is out of the true Wattle region, and only occurs with sparse, bushy trees. The two worst pests are the bag-worm and the caterpillar, both of which occasionally defoliate, in late summer, many hundred acres completely, and leave the trees thriftless, bark-bound and unhealthy, with the fair prospect of another visitation on the following year. Fortunately both have natural enemies, but there is an increasing danger as the Colony gets year by year more under Wattles that these pests may become an annual nuisance, and delay by one or more years the regular felling age.

Crop.—From what has already been said it will be evident that no very definite figures can be given as to the average returns. There are full Wattle crops in some outlying districts which are not considered worth barking when felled for fuel on account of the cost of barking and freight. In many districts the bark is marketable while the timber is not, and in only a few favourably situated plantations can both he turned to full advantage by the use of rail connection and tramway haulage. The profits made in these favoured spots are, however, proclaimed as inducements to further Wattle culture, and might be used as an excuse for raising freight; in both instances, however, an undue advantage would be taken of the foresight or fortunate position of the few to the detriment of the many. It must also be recollected that these few well-placed plantations are in the hands of the keenest business men, who carry their business methods into every transaction of culture, harvesting, marketing, etc., and that though these men earn high returns in Wattle culture they would have done so in any other profession or business, and their results cannot, therefore, be looked upon as indication of what the average man in the average place can do. The whole Colony, in so far as suitable, must be taken into account, including a much larger area where the timber is valueless than where it is valuable, and also many places where even the cartage and freight of the bark is a serious consideration.

The tonnage on certain classes of soil is fairly uniform, but the ton-value varies so much in accordance with concurrent expenses that an average serves no useful purpose.

Complete felling may take place at any period after five years of age, but ten years is nearer the average of felling. Assuming ten years as average age, I learn from many sources that a total of about five tons per acre of dry bark and 30 tons per acre of dry timber is the average return, though on deep

soil this is often exceeded, while on shallow or sandy soil it is seldom reached. Mine timber is only obtained from deep soil; on light soils fuel is the only timber product, and that only within a few miles of the railway. This estimate, though differently stated, does not differ from that made by Mr. Angus, who estimates about half a ton of dry bark and about three tons of dry wood per annum per acre of the total area under trees, which, of course, includes nine acres unproductive for every acre stripped during any one year. At Dalton, which is the centre of the Noodsberg industry, £6 to £6 10s. has been the average price during several years past for bundled bark, or about 20s. per ton more if ground and bagged. Fuel has run from £5 to £20 per truck of twenty short tons, with occasional times of no demand, while heavy mine timber has usually brought about twice the above prices.

At Hilton Road, which is more favourably placed with respect to market, especially up-country market, and where markets have been carefully cultivated, considerably higher values have been realised; while towards Mooi River even light timber has been sellable for mining purposes at good rates on account of the lower railway freight. Fluctuations in price must always be expected, and bark has ranged at times up to £15 a ton; but the recent scare about falling price and no demand seems to have had nothing more than an ordinary move to secure business as its origin. Advice as to whether wattle-culture will prove a very remunerative investment to any man, is, as has been shown, dependent on so many circumstances, including the personal equation of the man, that every case must be dealt with separately, but it is safe to say that on suitable soil, even in outlying districts, land can be purchased, fenced, put under wattles, and harvested at £7 per acre, while a low return of three tons per acre at £4 per ton on the spot is reasonable, and has the land and timber thrown in, showing altogether a profit of, say, a pound per acre per annum with little trouble. This is a distinctly low estimate; any intelligent man can do better, while not the least consideration is the practically unearned increment in land value which accrues in all wattle districts. A wattle crop, once sown, grows into value in accordance with surrounding circumstances, but its financial success depends, in every stage, upon the manager. One man can buy land at a payable price, while another fails altogether to do so, even with the same farm. One can take off six tons of bark an acre, with profit, while another, with the same crop, would only find four tons, costing more for removal than its value. The manager may be new to the work and still successful; he may also be well used to the work and a complete failure; but unfortunately his work reflects himself in every detail.

Prospects.—Fear is sometimes expressed that the Wattle bark industry may be overdone, and that the price of bark may sink so low as to be unremunerative. What may happen

when California, Australia, Cape Colony, and the Transvaal all join in production it is difficult to say, but for the present, Natal's quota to the total amount for tan-bark is insignificant, and does not suggest the probability of over-production for many years to come. Indeed, many English firms have not yet considered the Black-wattle bark to be of sufficient quantity and quality to warrant their putting down plant to deal with it, and though most of the Natal bark is shipped via England, a very large proportion of it finds its way into the Continental market, and the returns show over 2,000 tons shipped to Cape Colony since 1896, besides small lots to Egypt, India, Madagascar, etc. The future demand depends in great part on the quality of material sent forward, and if mixed bark, mouldy bark, and low-grade material forms a large proportion of that sent, the best buyers will soon place their high-price orders with the few firms who can be relied on to send first quality material only, while the balance will be slumped in "Natal low-grade," whether good or not, and bought only at what would now be considered unremunerative prices. So that every grower has in his power the opportunity to help or to hurt the industry as a whole, and himself at the same time. But there can be no doubt but that as in farming, shop-keeping, and everything else, the active and intelligent man can make Wattle-growing a profitable business at even lower rates than those now prevailing, while he who only slowly follows in the most slovenly methods he sees in use has little prospect of success, either in Wattle-growing or in anything else.*

*See also the last chapter in this Bulletin, concerning Mallet Bark, which has come into competition since the above was written. See also Quebrachio.

CHAPTER XII.

CULTIVATION OF ACACIAS, OTHER THAN BLACK WATTLE.

So much of the commercial interest in the genus Acacia centres in A. mollissima, while some of the other species are looked upon as noxious weeds, that it is well to state that the genus contains an enormous number of species, scattered over Australia, Africa, Asia, and America, including several valuable for timber, others for tan bark, others for nutritive pods, others for gum, and others for liber-fibre. Probably cultivation for any of these latter purposes has never been attempted, but for timber and bark several are in use and even in cultivation.

The Black Wattle so extensively grown in Natal is A. mollissima, Willd, but often classed as a variety of A. decurrens Willd; indeed, there are at least four forms which can all be grouped botanically as varieties of one kind, and yet are sufficiently different in appearance to be recognised by experts as distinct. These agree more or less closely in vigour, thickness of bark, and percentage of tannin, but variety *normalis* is credited with being more hardy than the others, and consequently better fitted for use in the higher districts, and wherever there is danger of damage from frost. The exact temperature at which damage occurs to either variety is, however, indefinite, for the concomitant conditions with regard to age, size, vigour, subsoil, drought, etc., cause diverse and often almost inexplicable results.

The natural habit of A. mollissima is a round-topped, rather squat tree, heavily branched, and usually as wide as high, with a short, stout main trunk (Fig. 56). When grown for bark in fairly close plantation it assumes an erect unbranched habit, the height and girth increasing much in rich deep valleys, as compared with poor ridges, though on elevated builts of deep soil it also makes a good growth. It is notable upcountry, and especially in the Transvaal, that wherever A. mollissima and A. dealbata grow intermixed the former is the better tree. In the upper midlands of Natal this is not so apparent, and it seems often the case there that A. dealbata is quite hardy, while A. mollissima is hardly so in its earlier stages, though as good as the other when once up.

A. dealbata, the *Silver Wattle*, is so similar to A. mollissima that trained observation is required to differentiate between the two, though the differences are specific. There are, however,

at least two varieties, the one a fairly good timber of rather slow growth, and the other a light brittle timber of very rapid growth while young. Like A. mollissima, it matures in about 15 years, though there are trees, as at Hilton College, still alive at nearly 40 years of age. Its bark is thinner than that of A. mollissima, and its percentage of tannin lower; its bark is also more difficult to peel, and often refuses altogether to come off, consequently for bark purposes it is a mistake anywhere to plant A. dealbata. This was not sufficiently recognised when Wattle culture began in Natal; indeed, the difference between the two was not known, the names were confused, both were considered valuable, and as a result many hundred acres of A. dealbata were planted for bark purposes before its lower value was ascertained. Now a constant war of extermination is going on; and it is being eradicated wherever A. mollissima does well, and it is not being grown for bark even elsewhere. The bark is not, however, without tanning value; in the absence of the other it might be worth cultivation, though the bark is thinner, the produce less, and the tannin percentage less, but there can be no doubt but that a considerable quantity of its bark has in past years been shipped as an adulterant of true Black Wattle bark. That, however, is practically a thing of the past, as the area under systematic plantation of A. dealbata is now small, scattered trees which are frequent, are seldom worth barking, and in any case A. dealbata requires a succession of wet years, or a time of heavy rain, to allow it to bark at all freely. The tannin trade apparently does not differentiate between the two, though the percentage of tannin is about 22 in A. dealbata, against about 30 in A. mollissima, both, however, being subject to considerable variation in accordance with age, vigour, part of stem, soil, climatic conditions, and many other factors.

It is not, however, for bark alone that A. dealbata has been grown. In the mining districts between Ladysmith and Charlestown it usually does succeed better than A. mollissima, and as props and fuel are both in demand its culture there for these purposes is sufficiently attractive to compensate for the loss of the bark value, the bark in these districts being seldom in condition to strip, besides being subject to a long freight to the coast. For mining purposes the timber of A. dealbata and A. mollissima is about equal, *i.e.*, the best of each is equal, and the worst of each is equal, but each species has enormous variation within itself, brought about by variety as well as by local conditions. The best is a really good, hard durable timber; the worst is a soft, spongy perishable timber, unfit for any technical purpose. As fuel A. dealbata is about equal to A. mollissima, and generally the weight of timber produced per acre is about equal in the two. For shelter purposes A. dealbata is valuable, especially on high and exposed farms, where other shelter is difficult to obtain, and it responds

to manure sufficiently to display greater vigour in cattle kraals than elsewhere.

For landscape effect A. dealbata is one of the most valuable trees we have, its light, glaucous foliage contrasting well with almost every other tree in cultivation, (except Blue Gum while its display of flowers is profuse.

The seed is much more difficult to collect than that of A. mollissima, being fewer in each pod, and the pods also are usually fewer, but to compensate for this it renews itself vigorously from suckers and root-buds; indeed, so much is this the case that these are at times rather a nuisance to keep down. The sucker plants cannot be transplanted, except with unusual care. A. dealbata ripens its seed a few months after it flowers, whereas A. mollissima takes over a year to ripen its seed. The seeds of A. dealbata, as of all other Acacias, require to be soaked in boiling water before being sown. On the coast its culture is not more successful than that of A. mollissima, both live, but cannot be said to be happy.

As *Acacia pycnantha* has the reputation of yielding a larger percentage of tannin than A. mollissima, it was at one time thought possible that it might supersede the latter for tan production. This has not worked out in practice, for wherever Black Wattle does well A. pycnantha does poorly, and whatever the percentage of tannin the relative production of bark per acre is so low as to exclude it from commercial competition. Mueller states:—"It is a tree of rapid growth, content with almost any soil, but is generally found in poor sandy ground, particularly near the seacoast, where A. decurrens would not succeed, and thus also important for binding rolling sand."

I am not aware that it has been tried on the coast lands of Natal; in the midlands its growth is distinctly poor, and it is less hardy than Black Wattle. It is now being tried on the sandy hills at Empangeni, Zululand. In Cape Colony its growth has been poor in the Eastern (summer rainfall) region, and not encouraging even in the West, where it failed on the Cape Flats, but succeeds along the lower slopes of the Table Mountain range.

Acacia saligna (one of the Australian Willows, and known in Cape Colony as Port Jackson Willow) was sown extensively on the poor sandy Cape flats, near Cape Town, with a view to place them under bush cover of some sort, and prevent the sand from blowing. In this it proved a perfect success, but it has also been found that the bark has a sufficiently high tannin value to allow it to hold the local market. Though not equal to A. mollissima, it thrives where that species cannot live, and consequently has advantage to the extent of the freight; it has not, however, been shipped abroad, nor is this necessary, as sufficient demand exists. It is a small, short-lived tree, mature in ten years, yielding a large amount per acre of good fuel, and consequently, taking bark, wood, and

reclamation all into account, it has proved a first-rate forestal speculation on these flats, where the following figures show the returns up till 1897:—

		Yield, lbs.		Average Price. £
1888	...	67,391	...	5
1889	...	65,659	...	6
1890	...	94,270	...	6
1891	...	94,600	...	6
1892	...	43,219	...	5
1893	...	48,035	...	4
1894	...	75,013	...	4
1895	...	182,597	...	4
1896	...	217,620	...	5
1897	...	85,731	...	6
	Total	974,135	Average £5 9s. 6d.	

This is from 1,425 acres, at Durban Road and Uitvlugt, of plantations mixed with A. cyclopis and Cluster Pine, and consequently less than half stocked with A. saligna, and it represents only the clearance to that date, but not the total clearance even of the first crop, while the crop continually renews itself.

At Port Elizabeth an enormous area of rolling sand has also been reclaimed by the use of this species, together with *A. cyclopis* (another Australian Willow), the latter being a smaller coast shrub, adapting itself readily to sand reclamation work, though of little other practical value, while the saligna eventually dominates, and yields a crop of fuel timber and bark. At East London also two sanddrifts were reclaimed by this means twenty years ago, the trees having since gradually died out, or been removed, to an extent sufficient to allow grass and other sand-weeds to claim possession.

On the Back Beach at Durban, and also wherever there is a threatened break in the sand dunes along the coast, A. saligna and A. cyclopis should be used together. A. saligna is not, however, confined to the coast, it can be and is used as a shelter belt in many places far from the sea, and it is also useful for that purpose on the hills within a few miles of the coast, where shelter is difficult to secure. The mixture of A. saligna and A. cyclopis is also most valuable for sowing on steep railway or bridge embankments, or such other slopes as require a quick and strong bush cover to hold the soil in position.

As a single tree A. saligna makes a nice garden specimen almost as rapidly as any tree known, it forms a low, bushy tree, flowering most freely, but also seeding most freely, and consequently sometimes troublesome to keep from spreading, though at the reclamation work at East London above referred to the absence of regrowth was a marked and unaccountable feature.

A cyclopis is the best pioneer of growth on sandy beaches quite exposed to strong sea-winds, and there are many such situations in which it can be used effectively as a hedge, where no other hedge is easily raised. A. saligna and A. cyclopis both grow from soaked seed in preference to being planted out, the root system being extensive and easily damaged at an early stage. Though A. saligna is used as a shelter it is too rough for use as a dressed hedge, but for this purpose another Acacia, viz., A. longifolia, is frequently used with good effect. Though inclined to be a tree if allowed to grow, it forms a dense, neat hedge if kept in form, its only fault being that it is rather short-lived, and that when mature and at its best single plants along the hedge die out, leaving gaps which cannot be filled. When allowed to grow on to tree size this forms a most effective ornamental specimen, especially if not made too common.

Acacia melanoxylon, *Blackwood* (Fig. 70), is one of the most ornamental trees introduced from Australia. Its flowers are not so conspicuous as those of most other species, but its rapid growth into a tall and handsome tree mark it out as one of the best for street, park, and garden planting. But its timber qualities also are such as to recommend it, the beautiful black timber being well worth attention. Concerning this Mueller states:—"The wood is most valuable for furniture, railroad cars and carriages, boat-building (stem and sternposts, ribs, rudder), for tool-handles, crutches, stethoscopes, some portions of the work of organ-builders, billiard tables, pianofortes (for sound boards and actions, and numerous other purposes); it has also come into use for casks, which need, however, previous long soaking. . . . . The Victorian Railway Commissioners report it for railway-carriages better adapted than almost any other timber, being handsome and durable, and not particularly expensive; wood from hilly country is also in this instance superior to that from low and particularly wet localities. The fine-grained wood is cut into veneers; it takes a fine polish, and is considered almost equal to walnut. The best wood in Victoria for bending under steam; it does not warp and twist. . . . . The bark contains up to 20 per cent. of mimosa-tannin."

Though common and mature throughout Natal, I am not aware of its timber having been used, or of its bark being utilised for tannin. If grown extensively for timber, probably this by-product might be of value. It grows luxuriantly throughout Natal, especially on the mist-belt, growing rapidly into a tree 50 to 60 feet in height and 18 inches diameter, with clean, straight bole, unless allowed to branch too freely. Large trees are not yet common, but probably on deep moist soils will eventually be so. It suffers during extreme drought, and consequently suffers more readily on shallow soil, or such as is apt to dry out completely. This accounts for its poorer growth in some upland localities, where flat rock underlies. It is usually grown from nursery transplants, but sowing in

situ at Cedara proved satisfactory, using 2lbs. of seed per acre intermixed with 20lb. Cluster Pine. This mixture was used to test the advantage of a nurse-plant of a different nature and lower value, which could be removed after it had performed its duty of keeping the Blackwood clear of branches. Previous experience has shown that the Blackwood can stand a good deal of shade, and that it has continued to grow satisfactorily under pines which were planted before it, and were consequently considerably ahead. It suckers somewhat, but the suckers do not transplant well; the suckers are increased in number by cutting the roots with the plough or spade, and this has been used for filling up a plantation originally too sparse.

Blackwood grows less rapidly at first than Black Wattle, but keeps it up longer, and is eventually a much larger tree, and of better timber form, and quality. It does not seed freely. A. melanoxylon should be one of the future timber trees of Natal, and planted extensively in suitable localities.

Acacia catechu, the Indian *Cutch*, has not, so far as I am aware, been tried in Natal, but may possibly suit Zululand. Its timber is of value, as well as its bark.

Several other species yield tannin, including the indigenous A. horrida, which, before the advent of Black Wattle, supplied most of the tanning material in Natal, Kaffraria, and Eastern Cape Colony, and A. arabica, which is used in North Africa, but the percentage is low, and cartage and freight consequently disproportionate to the value, so their use is only local where better cannot be had.

A. falcata, A. binervata, A. implexa, A. polybotrya, A. retinoïdes, and A. harpophylla are other species yielding tan bark, but it seems desirable rather to maintain a high quality of A. mollissima pure than to have a lot of species unless something really better, alike in productiveness and quality can be found, which does not seem likely.

Nor for timber purposes does it seem likely that any species of Acacia, other than those we already have, will come into use.

For the production of gum the cultivation of any Acacia does not recommend itself, though where there is very low-priced labour available the collection of gum from almost any species of Acacia may be profitable. All of the arborescent species of Natal yield gum, but its collection is not commercially practicable. In Cape Colony the collection of gum from A. horrida (Doornboom) by native children has occasionally amounted to several tons, but gives no promise of a permanent industry.

Among ornamental landscape features the Acacias take a prominent place. A. mollissima gives the Natal midlands the tree-clad appearance which strikes a stranger as unusual in South Africa; its foliage is very dark green and feathery, a striking contrast in colour to A. dealbata, which is glaucous-

green but of the same form, and both species have added beauty when covered with yellow blossoms. All the other species already mentioned are useful in scenic effect, but perhaps the most showy among others are A. Baileyana, a most profuse flowerer, and A. spectabilis (Fig. 76), a free flowerer of vigorous bush habit draped in silvery-white foliage. Acacia Farnesiana is cultivated in France for its scented flowers, which are used in perfumery, and A. cultriformis is another with glaucous-coloured foliage often cultivated. The indigenous species mostly inhabit and characterise districts known as the "thorn-veldt," having shallow soil and hot, dry climate, quite unsuitable for most of the exotic species. This class of country is looked upon with disfavour for any extensive tree planting, except upon selected spots, nor are any of the native species worthy of cultivation for technical purposes, though all are more or less ornamental as low flat-headed trees, the tallest being the white flowered species, known locally as the Camel-thorn (Fig. 88), though quite distinct from the Cameel-doorn of Kimberley.

CHAPTER XIII.

THE TIMBER OF BLUE GUM.

EUCALYPTUS GLOBULUS.

The utilization of Blue Gum timber has already been the subject of considerable discussion alike in the pages of the *Agricultural Journal* and in the columns of the public Press of this as well as many other Colonies and countries. The present position may be briefly stated thus:—

(1) The timber is recognised as having high technical value in its native countries;

(2) Australian Colonies in which it is not indigenous naturally push their own timber products in preference; and

(3) In Natal some have had unsatisfactory experiences of it, and many others doubt its technical value, as locally grown.

It may therefore serve a useful purpose to bring together some such information as is available on each point, and, if possible, show where the local prejudice finds origin, and what can be done to improve the value of the timber. But first it will be well to make clear what tree is being discussed, for several trees go by the vernacular name Blue Gum. Eucalyptus globulus is the Blue Gum of Tasmania and Victoria, and is the only species known as Blue Gum in Natal or anywhere else outside Australia. But in New South Wales, E. saligna is Blue Gum; in parts of Queensland, E. tereticornis is so called; in South Australia it is E. leucoxylon, and in other districts other species bear the name locally . But in Natal E. globulus and no other species bears that name, at least among those who know anything concerning Eucalypts. We have therefore only E. globulus to deal with.

(1) The timber is recognised as having a high technical value in its native countries.

The species was brought prominently into notice, and distributed all over the sub-tropical world by the late Baron von Mueller, who enthusiastically wrote:—"It is not too much to assert that among rather more than one thousand different species of trees indigenous in Austrialia, E. globulus takes the first position in importance, and among its own kinds it is the Prince of Eucalypts." In his "Eucalyptographia" he de-

votes many pages to its technical value, and in his more condensed "Select Extra-tropical Plants," the following occurs, *inter alia*:—

"The tree is, among evergreens, of unparalleled rapid growth, and attains exceptionally a height of 300 feet, furnishing a first-class wood. Shipbuilders can get keels of this timber 120 feet long; besides this, they use it extensively for planking, and many other parts of the ship. Experiments on the strength of various woods, instituted by Mr. Luehmann and the author, proved the wood of the Blue Gum tree, in average of eleven tests, to be about equal to the best English oak, American white oak, and American ash. The best samples indeed carried as great a weight as hickory in transverse strain, the ordinary kind about as much as that of E. rostrata. . . . . Blue Gum wood is also very extensively used by carpenters for all kinds of outdoor work, joists, and studs of wooden houses; also for fence rails, telegraph poles, railway sleepers (lasting nine years or more), for shafts and spokes of drays, and a variety of other purposes."

Mueller's writings are occasionally discounted somewhat as being too optimistic, but in this case he is supported by almost every writer who has had to do with Blue Gum in its natural home.

A pamphlet just to hand on Tasmanian timbers, published by the Tasmanian Government, states, concerning this species:—

"The grain, especially of the butt of the tree, is considerably crossed and interlocked; in the upper portions of the tree the grain is freer, and splits well when green. It is especially esteemed for piles, owing to the large size that it attains, and the comparative immunity it enjoys from the attacks of the Teredo. It is also used for ship and boat-building, the superstructure of wharves and bridges; railway sleepers and truck bodies; builder's scantlings of all kinds, joists, frames, beams, floor-boards; wheelwrights' work, for naves, shafts, swingle-trees, felloes, spokes, and body work. It is very durable both in the water—especially sea-water—and in the air.

"In the exhibition held in Hobart in 1894, among the Government exhibits was a sample of bridge-decking that had been about fifty years under foot-traffic, and which was still hard and sound. A timber also was shown which formed part of the original Bridgewater Ferry punt, built in 1818. The punt had been destroyed by blasting about fifty years before, and the wreck had been lying on the foreshore, between high and low water mark, and where there is Teredo, ever since. This timber, when cut out and planed in 1894, showed no sign of decay, and, beyond being stained by the iron fastenings, the wood was absolutely fresh. At the same exhibition were shown bent shafts, felloes, turned naves, spokes, and hammer handles, all cut from Blue Gum timber.

"In Tasmania the rainfall of different districts varies from twenty to sixty inches per annum; the Government railways are ballasted with gravel, and on these railways Blue Gum sleepers, six feet six by nine inches, by five inches, have an average life of fourteen years. The life of the wharf-piling in Hobart is reported to be twenty-five years. These piles are up to eighty feet in length, and are driven in forty feet of sea water, where they are subject to the attacks of the Teredo. The oldest wharf now in use was erected in 1868, and has stood till now (1902) without renewal. The waggon ferry-steamer plying across Hobart harbour, built of Blue Gum, has been running fifty years without any repair or caulking to the hull."

Experiments detailed in the same pamphelt show that the strength of Blue Gum timber is much greater than that of either English ash or English oak, and photographs are given of Blue Gum piles, 100 feet in length, awaiting shipment to England, one of which is here reproduced (Fig. 71).

In the *Natal Agricultural Journal*, 1901, page 348, the Surveyor-General of Tasmania maintains the high value of Blue Gum timber against a contrary statement, and quotes several high authorities in support. Of course, Tasmania has Blue Gum timber for sale, but I cannot doubt but what that Colony is offering a genuine good article.

(2) Australian Colonies in which it is not indigenous naturally push their own timber products in preference.

Who would not? Natal readers occasionally overlook the size and diversity of Australia, and when they find an Austrlian booming his native timbers without any reference to Blue Gum, are apt to conclude that the tree is there, what it is often considered here, a useless weed. But this occasionally goes further when Australians, who have never been in the Blue Gum Colonies, denounce Blue Gum because it only comes within their experiences as a cultivated sapling.

In a recent number of the *Natal Agricultural Journal*, Mr. F. E. Weaver, whose Australian experience, he states, has been gained in New South Wales, writes:—"Whoever advised the planting of Blue Gum for economic purposes knows absolutely nothing of Australian hardwood. In Australia the Blue Gum is only a last resort, even for fencing. I have had to do with timber for fencing, mining, housebuilding, etc., and have not yet seen a contract calling for Blue Gum."

This evoked the following reply from an ex-Victorian, now resident here:—

"Natal Central Experiment Farm,
"Reit Spruit, 3rd July, 1903.

"(The Editor 'Agricultural Journal.')

"Sir,—In your issue of the 12th June, there appears a letter upon 'Forestry in the Transvaal,' which contains a

sweeping condemnation of the Australian Blue Gum. As an Australian with many years' practical experience of forests and saw-milling, I would like to say that so far from being, as the writes states, 'only a last resort even for fencing,' the Blue Gum is, in Victoria, one of our most highly-prized timbers. Among the uses to which it is put in the Australian Colonies, a few may be here cited. In shipbuilding it is extensively used for keels, keelsons, beams and planking; in civil architecture wherever long, straight and heavy timber is required; in railway construction, as sleepers, beams for bridges and fencing posts; by wheelwrights it is used as spokes for wheels, and as body timber for all descriptions of heavy vehicles. In Melbourne there is more Tasmanian Blue Gum used in the construction of vehicles than all other hardwood timbers combined. The only objection, so far as my knowledge goes, that Australian railway engineers have against the Blue Gum, as railway sleepers, is that, when sawn or hewn into sleepers, it cannot be distinguished, even by experts, from White Gum, and other similar timbers, which, though quite valueless as sleepers, are often passed off as being Blue Gum. Over a great extent of South and West Gippsland, probably the most heavily forested part of Australia, Blue Gum is the only timber that has proved at all durable when used as fence-posts, and, of late years, 'Blue Gum posts' are always specified in contracts for fencing, and as 'blocks' upon which to support the superstructure of wooden frame-houses. Blue gum ranks in durableness with the red gum, ironbark and greybox, three of the finest hardwood timbers of Australia, but being of less specific gravity than those timbers, is therefore preferable for the construction of vehicles. Blue Gum is also less susceptible to the attacks of white ants than many other timbers.

"THOS. M. WHELAN."

The absence of Tasmanian Blue Gum from the collection of New South Wales timbers now being exhibited in Durban, and also shown at the recent Maritzburg Show, was noted and misconstrued by many who were not aware that this Blue Gum is not a New South Wales timber. The Blue Gum represented in that collection (E. saligna) is not in cultivation in Natal, except as a few single trees, but is probably the same as another importer was recently trying to sell the timber of in Maritzburg under the name of "Blue Gum," and which was certainly not E. globulus.

(3) In Natal some have had unsatisfactory experience of it, and many others doubt its technical value as locally grown.

This is partly prejudice and partly well-grounded experience. The want of durability of saplings as poles in the ground, the excessive tendency of larger timber to warp when

sawn, the difficulty of giving the timber a dressed surface, and the difficulty of splitting it into small firewood, are all well known to whoever has tried these.

In a letter published in the 'Agricultural Journal,' Messrs. Merryweather and Sons, Wagon Builders, Maritzburg, state: "The timber is tough, but in our opinion intractable. We have tried tons of it, but can never rely upon its keeping the shape in which it has been worked. Possibly when growing naturally in large forests, and not felled till forty or fifty years old, and possibly also specially seasoned, the remarkable inclination to twist may be absent, but on that point we cannot speak from experience."

Official experience is summed up in a reply by the Minister of Lands and Works, given in the Legislative Assembly, in 1896, to a question, which reply is thus reported:—"In 1892, the Government, on the recommendation of a committee, decided to make an experiment with 500 Blue Gum and 250 other native wood sleepers. In 1893 tenders were called for and accepted for the supply of these woods. The Engineer-in-Chief of Railways subsequently reported that the gum-wood sleepers had so twisted and cracked that they were useless for railway purposes. These sleepers were thereupon handed over to the Public Works Department. The Engineer of the Public Works Department reports that gum-wood has been tried for bridge work, but that, owing to the want of maturity, its use has not been quite satisfactory. He is of opinion that matured trees, felled at the proper season of the year, might, with advantage, be used for bridge work, and states that a hand-cart made some two years ago from selected gum-wood, is now as good as new, though it has been in constant use throughout that time."

A previous small experiment with Blue Gum and Wattle sleepers, made at Umsindusi Station in 1889, was also unsatisfactory, and the Committee on Test of Colonial Woods for Railway Sleepers reported on it as follows in May, 1892:—

"The trial of exotic timbers was on too small a scale to afford much reliable information, nor were sufficient precautions observed in the felling and seasoning of the timber. To this may probably be attributed the twisting and shrinking hollow, which is so marked and objectionable a feature in the sleepers now left in the road. As a sleeper, Blue Gum timber may still be said to be untried here."

Writing under date 30th November, 1898, Messrs. G. Fownes and Co., Rockwood Saw Mills, say:—"You won't think us unfair in saying our experience of Blue Gum is that of intense disappointment. The climatic influences are not as favourable here as in Australia; the outcome is most unsatisfactory."

Concerning a trial of Blue Gum timber for decking, made in the Passengers' Landing Stage, Durban, in 1897, with

planks nine inches by four, and twenty feet long, the Engineer-in-Charge reported:—"The difficulty in laying this planking was the most objectionable feature in the case, as nearly the whole of it was badly warped or twisted, and the planks varied as much as ¾ inch in thickness."

Regarding its durability in sea-water, in 1893, Mr. Methven, then Engineer-in-Chief, reported:—"Blue Gum submerged 7½ months, hardly touched by the Limnoria, but completely riddled by the Teredo."

This was on sawn timber, and the assertion having been made that the piles should be undressed as the astringent sap and bark are really the best protection against the worm, a further trial was arranged, and round piles driven in December, 1897, from which sections were cut a year afterwards, on which the Engineer reported:—"They have resisted the Teredo fairly well after being one year in the water, and from the result of this trial I should not hesitate to employ Blue Gum piles for temporary work, but a year's trial is far too short to decide whether Blue Gum is as good as Jarrah, and everything before has gone to prove that it is not."

The damage done was all in the sap-wood, and worst in a log which had been felled and air-dried for two years before being used, while the others had only been felled three weeks. I have quoted freely on purpose to show that the dissatisfaction with Blue Gum timber, as locally available, is too widely entertained by practical experts to be altogether an unreasonable prejudice, and I may add that in Cape Colony a somewhat similar experience obtains. In 1899 a series of selected logs of various indigenous and naturalised Cape timbers were sent to the Imperial Institute, and one of its expert referees on timber (Mr. Herbert Stone, F.L.S.) reported on their working qualities. Concerning Blue Gum he states:—"The sample was a very poor specimen, being a waney-edged undressed plank, twelve inches wide on one side, and eight inches on the other. It had been flat when first cut, as the sawmarks showed, but it had since swelled up in the middle of one side with sufficient force to rupture the tissue within, and produce a cavity which had no opening outwards, and which was only discovered when the plank was cut through. I do not remember ever having seen a similar defect in a plank. If this wood is liable to swell in this way, I consider it useless; but if due to want of foresight in the preparation of the plank, as I think likely, it may be ignored. This should be carefully gone into before any is sent out of the country, or loss will result, as its merits in other directions are few. Besides this peculiarity, the plank was badly cracked at one end to a distance of about twelve inches. It is a peculiar wood, the sap-wood being darker than the heart, which is a pinkish grey. It saws with difficulty, accompaned by a smell resembling acetic acid. It planes very hard and badly, or rather it does not plane, for the cutters rip the wood out in places, instead of

cutting, and a smooth or even flat surface cannot be obtained. It turns well, but is as hard as Turkey boxwood, and the fibres tear away, rendering a smooth surface out of the question. It polishes fairly well. Weight 51.09 lb. per cubic foot, or about 43¾ cubic feet to the ton."

There are those, however, in Cape Colony who, by selecting straight-grained timber, and having it properly seasoned, have found it valuable. I have seen wagons of which almost every part was Blue Gum, and in which neither warping nor cracking existed. I have also seen it used in preference to every other timber as handles for polo hammers, for which purpose its strength and elasticity make it valuable.

In the Cape Government Tree-planting Competition, decided in May, 1901, the judges in No. 2 area (Mr. C. B. McNaughton, Conservator of Forests, Knysna, and Mr. C. E. Legat, now Forestal Adviser to the Transvaal Government) reported concerning one plantation:—

"It is supposed by many in this country that the timber of the Blue Gum is worth little save for the roughest lumber, and for fuel. A visit to Schoonberg would, however, remove this impression. Here it will be seen that this timber can be used for almost any farm purpose, and that it is as useful as it is handsome in appearance. Inside the dwelling-house it will be noticed that this wood has been used for flooring, ceiling, and other boards, for tables, chairs, and other furniture. A handsome escritore, which was successfully exhibited at a Port Elizabeth Exhibition some years back, composed entirely of this wood, is an evidence of what can be done with the timber by cabinet-makers. Outside, a handsome cart, built entirely of Blue Gum wood, is to be seen. This cart has been in use now for some years, and its present condition is a strong proof that the timber is excellently suited for the purpose. Mr. Raubenheimer can also point to heavy and light spring farm wagons, which have successfully stood rough usage, manufactured from Blue Gum wood grown by himself. In fact, nearly all the timber used on the farm is a home-grown Blue Gum or poplar wood, and Mr. Raubenheimer considers the former equal to any he knows for any ordinary farm purpose. The heart-wood, he states, makes as good a fencing pole as any other species, and he shows as an evidence a fencing pole which has been planted some twelve years, and is to-day perfectly sound. The whole of the timber used has been cut from trees under twenty years of age. At Schoonberg, as elsewhere, the species is extremely fast growing. A height growth of thirteen feet in twelve months from seed is said to be not unusual. . . . . Experience has found that late autumn is the most suitable time for felling, and that seasoning is rapid and must be effected under cover. For general purposes the species must be close grown, and even then carefully selected for straight grain. A twisted grained tree is of comparatively little value."

Schoonberg is in the Long Kloof, not far distant from the well-known Outeniqua-Knysna forest range, where all the best timbers are abundant.

Conclusions.—Probably the reason for much of the difference between the quality of timber felled in Tasmania and that felled in South Africa is to be found in the Tasmanian forest regulation that no Eucalypt tree of less size than six feet in circumference at three feet from the ground shall be felled in the saw-mill and logging areas. Of course there are trees of that and of greater size in Natal, and such trees may have been used in the trials mentioned, though there is nothing on record to show that such was the case. But some of the Jarrah logs imported by Government into Natal measured 65 feet by 15 by 15 inches, and the Stringy -bark and Blue Gum logs now being exported from Tasmania to England measure up to 120 feet length by 20 inches square. Such measurements are far beyond the largest trees growing in Natal. It is where mature timber has been used that the favourable reputation of Tasmanian Blue Gum has been earned; it is where immature timber, such as Tasmania does not allow to be cut, has been used that it has gained an unfavourable reputation.

In a local newspaper cutting concerning Blue Gum timber a correspondent states:—

"My contention is that the timber of a 30 year old tree is just as good as that of 60 years, for if, say, a tree of 30 years of age is 12 inches in diameter, and at 60 years 24 inches in diameter, must not the last 12 inches produced in the second term be only 30 years old, and therefore the statement about age is a fallacy."

But the writer omits to mention that the larger and older stem consists of 12 inches of more or less matured heartwood surrounded by a six inch ring of sapwood, while in the smaller stem the sapwood is present but the hardwood is absent. Take Sneezewood as an illustration. A forest grown tree with a diameter of 6 inches is often entirely sapwood though 20 or more years old, and is absolutely useless as a fencing pole; when 12 inches diameter 8 or 9 inches are imperishable hardwood, surrounded by soft sapwood, and when 24 inches diameter almost the whole of the timber is durable.

This also has much to do with the warping and cracking. From an immature tree it is difficult to cut a plank of nearly equal density throughout. One side is less mature than the other, and contracts more in drying, causing a concave board; or one edge is less mature, causing a crescent-shaped flat board; or from a tree with much taper one end, and possibly also one side is less mature than the other, resulting in eccentric contortions; and all these forms of warping are affected by every change of weather. Now, with thoroughly mature timber, of equal density, this does not happen to a serious extent, though in other valuable timbers besides Blue Gum, including the New Zealand Kauri Pine and the South African

Yellow-wood, attention has to be given to this in felling and sawing. The immature nature of the Blue Gum timber usually felled here is also shown by its tendency to crack, the outer and softer sapwood shrinking laterally more than towards the centre and consequently causing one or more ruptures of the tissues. Maturity, and then sawing timber of equal density, are the best preventives of warping and cracking, though by mechanical pressure, slow drying under cover, or immersion, immature timber may, to a certain extent, become rigid without losing form.

Another source of complaint is that the timber in the centre of the tree is occasionally not sound. Trees growing on soil which does not suit them, such as shallow soil overlying shale, and trees which have been damaged by external injury or by white ants, frequently decay in the centre. This is only an early realisation of what happens in Tasmania, where the timber of an over-mature tree decays from the centre outward. The cure for this is to avoid the inducing conditions, and grow Blue Gums only where they can mature unmolested.

Twisted grain is not an uncommon occurrence in Blue Gum. This usually occurs where trees are planted far apart in rather poor or shallow soil. Such trees produce numerous branches and leaves; these all have a certain imperceptible motion towards following the direction of the sun day by day, which eventually produces a decided twist in the grain. Where the height growth is rapid and the branches few this twisting is less marked, and dies out with age; consequently, reasonably close planting followed by thinning as required prevents the formation of branches and induces height, and thereby saves the timber.

The following remarks on Tasmanian trees are from the pamphlet already quoted:—"Young and free-grown trees will give a very different class of timber to that got from a slow-grown tree of the same class. . . . . Then trees, acknowledged to be exactly the same kind, will produce very different timber, according to where they grow. For instance, upon a rocky eminence or in a sheltered river-bottom, the timber will differ in texture, in colour, in durability, and in weight, according to soil and situation."

I have hardly referred to seasoning, though that is an important factor even in mature timber, and much more so in immature. And, especially with immature timber, it is important to reduce the flow of sap by ring-barking six months or more before felling, and to exhaust the sap as far as possible by transpiration, by leaving the branch, twigs, and leaves unlopped for a few days after the tree is felled.

The Blue Gum was introduced into Cape Colony in 1828 by Sir Lowry Cole, and the first trees planted in Natal came from there about fifty years ago. For some years transplants were dear and seeds scarce, consequently the older trees stand singly, and are heavily branched, more or less twisted in the

grain, and of much taper; indeed, I doubt if any tree here would square to 18 inches fifty feet up. All these are bad qualities, which can be avoided by fairly close planting, but I mention them because the first heavy samples are not likely to be fair guides to what the Blue Gum can do under proper forestal treatment. The Tasmanian samples may rather be taken as showing what time will eventually produce, for with well selected soil there is no climatic reason here for a difference, at least in the Midlands and upper districts.

At the instance of the Committee on Test of Colonial Woods for Railway Sleepers (Natal) the Conservator of Forests in 1891 obtained all available information with regard to the acreage and age of Blue Gum plantations in Natal within 40 miles of the Railway, which he summarised as under:—

Area of Plantations in Acres.					Number of Trees.		
Years old.	Under 5 years.	5 to 9.	10 to 14.	15 to 19.	20 to 24.	25 to 29.	30 and up.
	393	1,610	497	332	4,673	2,931	1,997

Planting of Blue Gum has not been largely practised since that time, and the total area in the Colony probably does not exceed 3,000 acres, and much of it so grown as to be of little technical value for many years, if ever. Still I trust I have made it clear that well-grown material may be expected to eventually have high technical value, which is in danger of being lost sight of through the bad reputation now being earned by pushing on the market unmarketable material. But for those who wish to thin out now, or to fell what cannot improve, I need only recall what happened in Cape Colony ten years ago, when a small 13 year old Blue Gum plantation of 60 acres at Worcester was felled, sold, and delivered by Government, mostly to a Kimberley dealer, for a total of £18,480 6s. 6d., of which part was railway freight, but all was revenue to the Colony.

These were used for mining props, and in a recent number of the *Agricultural Journal* (page 235) the present value of Blue Gum mining props is stated at 1s. 6d. per cubic foot as they stand in the plantations at Johannesburg.

And it may be that some will find its way into temporary works at Durban Harbour, though when quotations were advertised for in December, 1898, only two communications were received, and since then a contract for temporary piles was so slowly supplied that Government had to import Australian timber to allow the work to go on.

The finest single tree seen was on Mr. Jos. Baynes' estate at Nel's Rust, and the finest group was in a vley at Mr. Henderson's farm, "Hilton," where only a few feet of soil overlay stiff clay, but where fine clean boles of enormous height were produced, clear of branches, and without any bend, twist, or other defect.

CHAPTER XIV.

THE CULTURE OF EUCALYPTS.

It is a curious fact that the trees which give Natal its noted landscape beauty, and which draw the attention of visitors, are, for the greater part, exotics, introduced and naturalised within the past forty or fifty years. This is more particularly the case along the lines of railway, whence indigenous "bush" has almost disappeared, while a very considerable area has been planted with Australian Gums and Wattles, which are dotted all over the midlands, and not quite absent either on the coast or in the more inland districts. The adaptability of these kinds to local conditions and their rapid growth have secured for them an amount of attention which the more slow-growing and fastidious indigenous species were, in the presence of these, not considered deserving of, and now some introduced kinds have started seeding the country and taking possession. The Black Wattle industry has already developed into one of considerable importance, and the culture of Gum trees only requires careful handling and guidance to make it also an industry well worth commercial attention. Up till now commercial Eucalpyt culture has been almost confined here to the growth of Blue Gum (Eucalyptus globulus), with which I dealt in the last chapter. Fortunately, however, a large number of other species have been planted experimentally throughout the Colony, and now show the comparative results obtainable under different conditions; unfortunately, these experiments have in almost every instance been confined to small sample lots of a few trees or a few hundred trees, so that a timber industry on extensive commercial lines, in even the best known and highly valued kinds, has still to be started. A very few planters, among whom may be mentioned Mr. Topham, Mr. J. Medley Wood, A.L.S., Hon. Jos. Baynes, M.L.C., and the late Mr. Wilkinson, have done much to keep themselves and the public informed concerning the comparative value of the kinds introduced, but to the average planter a gum tree was a gum tree, and nothing more, whether it was a Jarrah, a Karri, an Iron-bark, a Stringy-bark, or a Blue Gum. This still holds good, and while the public now recognises that there are valuable as well as useless gum trees, few know even now which kinds to plant, or which to avoid. Many hundred species of Eucalyptus have been described; at least 130 of these are maintained as distinct species, and the number of intermediate forms and probable hybrids is very large indeed. Some are dwarf shrubs, several are trees attaining

400 feet height; some are useless for timber purposes, others most valuable timbers; some are tender coast species, others hardy mountain kinds; some are fastidious as to soil and moisture, others show no such trait. It is then desirable to have a ready reference to such information as is available with regard to the behaviour in South Africa of each of the more important species, especially with regard to growth; for only in a few instances has the timber come to such maturity here as yet as to show its technical properties. The notes given hereunder are, except where otherwise mentioned, from my own observations in Cape Colony and Natal; but with respect to the timber value we must in most cases accept the testimony of Australian experts, knowing that the climatic conditions here will usually produce similar quality of timber, when fully mature as is produced under similar conditions in the native habitat of each species; and such expert evidence has accordingly been included. It has also been considered desirable to introduce references to the reports of culture of various species in other parts of the world, especially in Southern California and Arizona, where climatic conditions much resemble those of Natal, where Eucalypt culture is of about the same age as in Natal, and whence reliable information has just come to hand in a United States report. The somewhat mixed nomenclature considerably increases the difficulty connected with species, and even now alterations in specific names are going on as the result of further investigation into the limits of species and the types selected by earlier authors.

CULTURE.

Seed.—Wherever it is possible to obtain seed from trees in one's own neighbourhood that should be done, especially if from an isolated tree, or from a clump of one kind distant from other kinds. In such cases hybridization is less likely, and the result is a crop of trees of one variety and of equal growth, while more or less naturalised seed may be relied upon in preference to that from a different climate, and there is at least the advantage of being sure the seed is fresh. Where many kinds are inter-mixed, hybridization is almost sure to occur; this may not be objectionable if only fuel or temporary props are wanted, except that it produces some trees more vigorous than their neighbours, which are consequently dominated, but in the production of good timber an equal kind and quality throughout should be aimed at, and hybrids are then to be avoided. Seed purchased from Australia is frequently mixed, though the more important kinds are usually pure, being collected in quantity from single large trees felled for timber.

The seed is always and naturally mixed in the capsules, more or less, with chaffy seed-like material, which is often difficult to separate from the seed and sometimes indistinguishable. This chaff leads many to sow too thinly, considering

that they are sowing a very large number of seeds, while actually they are only sowing a few. Clean seed, that is seed clear of chaff, is worth many times as much as the same weight of undressed seed.

In collecting the seed, if a tree has been felled or a branch lopped, collect the mature capsules only, and do so on the day of felling, or, at latest, on the next day. These may be left to dry in a tin or box, and stirred occasionally to make the seeds fall out of the drying capsules, but it is preferable on the first bright hot day to spread out the capsules on a cloth or roof-iron fully exposed to sunshine but not to wind, and to turn the capsules occasionally. By this means almost all the seed will be shed in one day. If the capsules are not collected from the trees soon after felling the seed will be already shed.

Sowing.—The seed may be sown either in well-prepared open beds, or in tins or boxes. The seedlings are more easily controlled in tins, as in beds the taproot is apt to grow too vigorously, and form insufficient lateral roots, whereas the check produced by the tin induces abundant lateral roots and no development of the taproot. In either case the soil should be well drained and in fine condition, with a level fine surface upon which the seed is sown and covered with a light sprinkling of fine sand or sifted soil, the seeds being barely covered. If sown a half-inch deep, or if roughly raked in, they have every chance to be buried, and fail to germinate. The bed or tin should be kept moist and shaded under a calico awning or a light covering of dry grass until germination is completed, after which the shading should be gradually removed, and the plants hardened by exposure, at first at night only, but afterwards by total exposure except under bright sunshine.

Transplanting.—The most convenient method of handling gum seedlings is to prick them out into half paraffin tins, having holes punched in the bottom and thoroughly drained. Twenty-five to thirty seedlings, two inches high, can be put separately in each tin, and grown on until they are four or five inches high, when they are ready for planting out permanently. If the seedlings have been raised in a bed they may have too long taproots to allow them to be pricked into tins; those taproots require to be pruned back to not more than two inches length, and to be planted straight (*i.e.*, without being bent round), and if the plant is so vigorous as to be likely to suffer by such pruning, then the stem also should be pruned back to about two inches length. The plants should then be shaded again for a few days.

Teasing.—Sometimes, when tins are scarce, resource has to be had to the method of "teasing" the roots in the nursery beds; that is, lifting and replanting the seedlings frequently in the nursery, so as to produce few main but numerous lateral roots. These plants are by this means kept more or less stunted and thrifty while in the nursery state, and when at

length they are ready for planting out, and the sites ready for them, they are wrapped separately in little masses of stiff clay, and planted in that condition. At Johannesburg this used to be the favourite method of moving gum-transplants from the nursery to the plantation for planting out, and many million trees have been thus treated, often moved for considerable distances, the clayed roots being packed tightly together in large cases. I do not recommend this method where tins are available, but mention it as practicable if necessary.

Planting Out.—For extensive plantation work the trees should not be more than six inches high, nor less than three, when planted out. Larger trees require special care, and are apt to die off even then; and smaller trees hang too long before asserting themselves, and are apt to get lost among weeds, unless specially cared for.

The soil should have been well prepared by ploughing and pulverising some months previously, and should be mellow and friable. The plants are brought to the ground in the tins, and removed one by one, just as the operator is ready to plant each. The ball of soil around the root should be kept as intact as possible, and the rootlets spread horizontally in the bottom of the shallow hole dug with the trowel for its reception before being covered up and the soil pressed firm. One good watering to settle and moisten the soil is usually all that is required, if the planting is done, as it should be, during the rainy summer months.

Espacement.—This varies with the kind, and the purpose for which the plantation is being made. For timber, most kinds should be planted five feet apart each way, but thinned as soon as the canopy can be kept close by the remaining trees. Branching kinds require to be kept close longer than others, on purpose to control the tendency to branch. The most rapid growers may, in clean deep soil, be planted ten feet apart each way. For shelter and ornament even wider planting may be adopted. For timber purposes, however, the trees should be close enough to prevent heavy branches ever being formed, height growth should be induced, and rapid, clean, untwisted timber aimed at, the espacement being the main means of control of all these.

Sowing in Situ.—Though not a usual proceeding, and likely to be often a failure, some growers have been successful in sowing gum seed broadcast, where the trees are to remain. To do this successfully it is necessary to have the ground all ready, waiting the advent of heavy rain; and when this is fully expected harrow to a fine surface, and sow, leaving the rain to do all the covering that is necessary. Where kinds are acclimatised this process goes on naturally, self-sown seed coming up freely in some cases. Thinning to the necessary distance apart, or filling up if necessary, should then be done during the first or second year.

Peculiarities of Species.—While in the nursery stage some kinds require more care than others. Thus E. diversicolor and E. citriodora are apt to suffer from even slight frost, and consequently require to be covered if frost is expected; E. citriodora, E. ficifolia, and E. marginata grow so vigorously that they are apt to suffer when transplanted unless cut back; E. leucoxylon is apt to have a procumbent habit during the first year; while many species send their roots through the tins into the soil below, except moved from one place to another, and the extending roots removed, every few days.

Trees for ornamental and shelter purposes are often grown on to a larger size in separate tins, and sometimes only planted out when several feet in height. Such trees require different soil preparation, as ploughing does not alone give sufficient depth of loose soil to meet the requirements of the larger ball of roots. A separate hole for each then becomes necessary, but this hole should be as wide as possible, but of comparatively little depth. A deep hole almost invariably becomes a water basin, in which the roots are confined and suffer, and eventually die, consequently the whole planted area should be turned over to the same depth.

Fencing.—It is absolutely useless to plant trees without first fencing the ground, as stock invariably find access, and usually do permanent injury. Some species, as E. corynocalyx and E. Gunnii, are readily browsed by stock, others are distasteful to them but still suffer through being tramped down or rubbed against.

REMARKS CONCERNING SPECIES.

EUCALYPTUS ACMENOIDES, SCH.

"WHITE MAHOGANY."

Known in South Africa only in its younger stages; of rapid growth in deep alluvial soil, but a total failure in the sheltered valleys among the calcareous coast sand dunes at East London. Seedlings have opposite leaves and branches, like E. pilularis, but the leaves are wider and shorter. In New South Wales it grows to be a large tree; its timber is said to split easily and be durable, and useful for building purposes, flooring boards, slabs, rails, and palings. Maiden states (Notes on the Commercial Timbers of N.S.W.):—"It is one of the most durable timbers in New South Wales. I know of posts of it in different parts of the Colony quite sound after the vicissitudes of more than half a century. . . . It is a

tough, strong, useful timber. . . . . It is one of those timbers which is not as well known as it should be, because it has been constantly confused with others. It is excellent for posts, piles, girders, etc., and is useful for general building purposes." Formerly included as a form of E. pilularis.

EUCALYPTUS AMYGDALINA, LA BILL.

GIANT GUM.

This species occurs in several varieties, under different common names, in Tasmania, South Australia, Victoria, and New South Wales. It is usually within the influence of sea-breezes, and prefers humid mountain glens, where, in deep alluvial soil, it produces probably the tallest tree of the world, measurements of over 400 feet in height and 30 feet in diameter having been recorded from the variety *regnans* (the Victorian Blackbutt). On dry ridges smaller growth but more close-grained and durable timber is obtained from the smaller-leaved variety, which, in its seedling stage, much resembles E. viminalis in its warty branches and narrow opposite leaves. Concerning its timber Mueller states:—

"The timber is useful for many kinds of carpenter's work; in drying it does not twist; when straight stems are produced in forest-valleys the wood splits better into palings than even that of our stringbark tree, and this with such facility, that in some particular instance a labourer has split 620 palings of five feet length in one day; the timber is comparatively not heavy as it floats in water, unlike that of many Eucalypts; it is particularly well adapted for shingles, palings and rails, and also drawn into use for shipbuilding, especially keelsons and planking, but it has not been found very lasting underground and does not afford a superior fuel."

The timber appears, however, to vary in accordance with the variety and the conditions of growth, and in the pamphlet issued by the Tasmanian Government, the variety *regnans* is recommended as of great strength and excellent for furniture-wood, though not durable in the ground or when exposed to the weather, while the narrow-leaved variety from the dry ridges, known locally as "Peppermint," is said to supply the most durable wood of any of the gums in the State, and to be in special demand for fence posts.

This species yields a very large percentage of volatile oil, and as it endures moist heat better than most other species, it may be useful for hygenic purposes in the coast malarial districts of Zululand. It also endures a lower temperature than Blue Gum (E. globulus), and many good specimens exist throughout Natal and Cape Colony, though being mostly under twenty years of age, they seldom exceed eighteen inches

diameter and eighty feet height. In the higher districts it is not so vigorous as E. viminalis and E. rostrata, and on hard dry ridges it is seldom satisfactory, but in alluvial bottoms in the midlands and coast ward its growth is excellent. Habit tall and upright, with a distinct main trunk, and small drooping twigs. One variety—E. angustissima—has an equally good habit as a timber tree, but leaves only two or three lines wide; in ornamental planting this variety is very desirable, as its appearance differs altogether from any other gum.

Concerning the behaviour of E. amygdalina in North America, McClatchie writes:—"The tree endures low temperatures, but is injured by dry heat. It does best near the coast and at moderate elevations in well-watered mountain regions. In no part of the South-west do the requirements seem fully met."

EUCALYPTUS BOTRYOIDES, SMITH.

Usually a flat-topped spreading tree, admirably adapted for street tree-planting and other ornamental work, its horizontal leaves and medium height producing a dense canopy twenty to thirty feet above ground. It is frequent in Natal and in the Eastern Province, Cape Colony, where it is hardy up to 4,000 feet alt. Grows rapidly, but does not produce a heavy stem early. In Australia its timber is recommended by Mueller and Bailey for wagon-work, knees of boats, fencing, posts, etc., but several forms occur, having different vernacular names in accordance with habitat as it frequents coast sands as well as alluvial soils, and probably on account of this diversity of situation it is not always esteemed equally.

EUCALYPTUS CALOPHYLLA, R. BR.

RED GUM OF WEST AUSTRALIA.

This species, which is easily known by its very large urn-shaped capsules, is, during its earlier years, one of the most beautiful trees in cultivation, having large deep-green parallel-veined leaves, and abundant panicles of large white flowers. Except on rich alluvial soil it does not, however, maintain its beauty, and on shallow soils soon becomes a stunted scraggy tree of small size. It is often used for street tree planting where the soil is deep, and frosts not severe; but never realises here the descriptions given of its growth in West Australia, where it is said to be a fairly large tree, producing strong light timber useful for rafters, spokes, and fence rails, but not durable. Frequent in the coastward districts of Cape

Colony and Natal, but I cannot recall a specimen one foot in diameter, or more than twenty-five feet in height. Along the North Coast Railway it is, as might be expected, making poor growth in shallow soil overlying shale.

Concerning its cultivation McClatchie states:—"In America it has succeeded only in the warm coast regions, failing entirely in the dry interior plains and valleys. In no locality has the rate of its growth been such as to give promise of much usefulness as a forest tree.

EUCALYPTUS CITRIODORA, HOOKER.

LEMON-SCENTED GUM.

A great favourite when young on account of its strongly scented foliage. It grows rapidly, forming tall, straight, unbranched stems, having clean white bark, and only sparse foliage at the top. It is consequently not a shade tree, but in the production of straight spars it equals Blue-gum, and surpasses almost all other species. It is tender in upland districts, but succeeds in more tropical climates than most other gums, and may be found useful in the malarial coast region of Zululand, which is too moist and hot for Blue-gum. The seeds are half-inch long, and the seedlings so vigorous that they transplant with difficulty; the surest method is to prune hard back when transplanting. Concerning its timber Mueller states:—"The hardwood of E. citriodora is used for studs, which, after twenty years, show no decay; it is furthermore liked for fencing, as it splits well, also for shafts of drays, as it is more pliable than most other Eucalyptus-timber, bending readily, and it is also used as material for wheels." Maiden also recommends it for fencing, implement handles, shipbuilding, paving, railway-ties, bridge-building, lumber for inside woodwork of homes, carriage-making, and for railway coaches; and McClatchie, who reports favourably on its growth in the frostless coast regions of North America, adds that the value of the timber is due to its strength, elasticity, and beauty, and that it is said to be replacing America hickory, in Australia, in coach factories along the coast.

Frequent in Durban, Maritzburg, and Ladysmith, also in East London, King William's Town, etc., usually doing well, and it does not appear to suffer readily from white ants. Considered the more tropical form of E. maculata.

EUCALYPTUS CAPITELLATA, SMITH.

ONE OF THE STRINGY-BARK TREES.

Like all the other true Stringy-barks, this tree has a tall more or less unbranched straight stem, and is frequent and satisfactory in its growth in Natal. A tree 23 years old

at Wilkinson's Nursery, Maritzburg, has 70 feet height and a diameter of 24 inches. It is unfortunate that none of the Stringy-barks (which include E. capitellata, E. eugenioides, E. obliqua, E. macrorhyncha, and E. Baileyana) are durable in the ground, though often used for sleepers, where they abound naturally in Australia and Tasmania, and from mature material said to last from seven to twelve years. But they are all straight, split easily, saw well, and are useful for many purposes, including house-building and wagon timber, etc. They are all easily cultivated, and grow freely.

EUCALYPTUS CORIACEA A. C.

(See under E. pauciflora.)

EUCALYPTUS CORNUTA, LA BILL.

THE YATE TREE.

A medium-sized tree, inclined naturally to form a branched and bushy crown, and consequently admirably adapted for use in parks, street tree-planting, and shelter belts. It grows rapidly to 30 or 40 feet in height, with a stem diameter of 18 inches if in fairly deep moist soil, but also continues to thrive, though more slowly, in dry hot ground. Mueller states that it occurs also in limestone ground, and thrives even in moist tropical climes, and that its timber, which is very heavy, is preferred in West Australia for the strongest shafts and frames of carts and other work requiring hardness, toughness, and elasticity, and is considered equal to ordinary ash-wood. It is frequent in the Eastern Province of Cape Colony, as at King William's Town, East London, Grahamstown, and Queenstown, but has not been noticed by me in the Western Province nor in Natal, except one tree in Wilkinson's Town Bush Nursery, Maritzburg. The dwarf variety E. Lehmannii, Pr., which is common in Cape Colony but absent from Natal, seldom exceeds 15 feet in height, and has curious large clusters of congested capsules; it makes a very distinct and pretty small tree for a lawn, and is occasionally used as a street tree with good effect where a whole line is of one kind. E. cornuta is so apt to branch that it requires to be planted closely and kept pruned if straight timber is desired. As it comes from a country having winter rainfall and a hot dry summer, climatic conditions in Natal are not favourable for its growth, though in the Eastern Province of Cape Colony, where it does well, climatic conditions are similar. Concerning its growth in California,

where it is mostly used as a shade tree, McClatchie writes:—"The Yate endures high temperatures, but will not endure heavy frosts. It thrives on the coast and endures the dry hot summers of the interior valleys of California and Arizona, provided its roots are supplied with plenty of water. It endures temperatures of 110 deg. to 116 deg. F., but is injured by minimum temperatures of 23 deg. to 26 deg. F. It prefers a rich moist soil, but will make a fair growth in poor soil. It seems to be well adapted to moist tropical and semi-tropical regions, enduring more rain than many other Eucalypts."

EUCALYPTUS CORYMBOSA, SMITH.

THE BLOOD-WOOD TREE.

One of the few Eucalypts which does fairly well in the coast-ward districts of Natal. In South Eastern Australia it is said to grow to a large size, and to produce durable dark-red wood suitable for fence-posts and rails, as not easily set fire to; used also for railway sleepers, etc., and resistant to white ants. It is said that the presence of Kino renders the timber unsuitable for lumber, and causes it to make poor fuel, but renders it more valuable for paving, for posts, and for other uses in underground situations. It splits easily. In Wilkinson's Nursery, Maritzburg, a tree about 23 years old has a clean straight bole 60 feet in height and 12 inches diameter.

EUCALYPTUS CORYNOCALYX, F. V. MUELLER.

THE SUGAR GUM.

This species, which in South Australia is a fairly large tree, has not thus far shown any tendency here to exceed medium height, and is usually a flat-crowned tree of 30 to 50 feet in height, and of rather slow growth. Its twigs have a yellowish colour, which makes it a distinct and effective street tree. Not uncommon in King William's Town, Queenstown, etc., a nice plantation of it exists at the Trappists' Station at Centocow, Dronk Vlei, and there are nice young trees of it in the Alexandra Park, Pietermaritzburg. It branches freely, and requires to be planted closely to produce single stems. It has an Australian reputation for doing well in hot waterless regions as well as on dry ironstone ridges inland, but here it prefers soil and atmosphere not very dry. It requires thorough protection from stock, as, like E. Gunnii, it is readily grazed by cattle and goats. Concerning its timber Mueller states:—"The wood is remarkably heavy, very dense, hard and strong,

less liable to warp than that of many other kinds of Eucalyptus-wood. It has come into use for fence posts and railway sleepers, naves, and felloes. Its durability is attested by the fact that posts set in the ground 15 years showed no sign of decay." And Gill says:—"The wood is hard, dense, and durable, losing but little in seasoning; it weighs when dry, generally 65 to 70 lbs. per cubic foot. It is yellowish brown in colour, often showing a handsome wavy grain. It is used for posts, rails, piles, wheelwrights' work, and railway sleepers; also for furniture; selected specimens cut to veneers have proved very effective, while for paraquet flooring, in common with several other Australian timbers, it possesses many serviceable qualifications." In California it has been found to thrive alike on the Pacific coast and in dry inland valleys, and while it endures drought it likes moisture.

EUCALYPTUS CREBRA, F. V. MUELLER.

NARROW-LEAVED IRON-BARK.

The four Iron-barks, E. paniculata, E. crebra, E. sideroplloia, and E. sideroxylon, are placed by Maiden in the above sequence as their order of importance, and collectively he states concerning them:—"Ironbark is the King of New South Wales hard woods, in fact it is not excelled in any part of the Continent for combined strength and durability. It is extensively used in bridge construction, for railway sleepers, for posts, for naves, spokes, shafts, and framing, by the wagon and carriage builders; for large beams in buildings, particularly in stores for heavy goods—in a word, wherever great strength is required. For such purposes as railway-sleepers it will last an indefinite period, and in many cases has to be taken up, not because it shows signs of decay from exposure on the permanent way, or disintegration because of the vibration to which it has been subjected, but because holes have been made in the sleeper by the renewal of bolts and spikes. I have specimens of sleepers which have borne the heaviest traffic of the main line near Sydney for 25 years, and which are as sound as the day they were laid."

E. crebra is less hardy than the others, and thus far has made rather slow growth in Cape Colony, and has not made rapid girth growth in Natal, though many specimens exist with tall clean stems of 60 feet height and 6 to 9 inches diameter as the growth of 10 to 15 years. It is slower growing but less branched than the other Ironbarks, and has been noticed along the coast, and up as far as Maritzburg.

EUCALYPTUS DIVERSICOLOR, F. V. MUELLER.

THE KARRI.

An enormous tree, belonging to the southern and coastward portions of West Australia, where it occupies mostly deep chocolate and sandy soils. It is easily damaged by frost, and suffers also from extreme drought, especially over a solid rock subsoil, even though at considerable depth, its rapid growth causing a demand for moisture unusual even among Eucalypts. It is one of the most ornamental species for park or avenue purposes so long as it retains its lower foliage; it has no distinct leader when young, but eventually forms a grand single bole of straight clean timber unbranched for a long distance up, if grown in forestal espacement. At Tokai Plantation, near Cape Town, it is making splendid trunks on the steep mountain side; at King William's Town there are fine old trees in the cemetery, and in Maritzburg there are several good trees, two branched trees 23 years old in Wilkinson's Nursery being 80 feet height, by 2 feet diameter, while five others are 90 feet height by 14 inches diameter. It is one of the most promising species for culture on a commercial scale below 3,000 feet altitude, especially within the influence of mists and sea breezes, but not quite on the coast, and it should not be used on shallow shale or in Thorn country. Its foliage being horizontal, it gives denser canopy than other Eucalypts; it also produces and sheds more leaves than other kinds, and so forms a humus layer of top soil; and if planted reasonably closely it soon kills out all weeds by its density of cover. Seedlings are easily raised and easily transplanted when small, but are more subject to damage by frost than any other Eucalypt. It has proved satisfactory in deep alluvial soil and humid atmosphere in Ceylon, California, and Algeria, and is subject to a heavy winter rainfall in its native habitat, where it attains a height of 400 feet.

The timber is imported in quantity into Natal, Cape Colony and the Transvaal for planks, beams, boards, etc., mostly for use under cover and for mining purposes of a temporary nature, its durability in contact with the soil, or when exposed to the weather being somewhat doubtful, as it weathers in shreds like stringy-bark. Mueller states:—"Furnishes good timber for building, even for masts, likewise for planks; also valuable for shafts, spokes, felloes, fence-rails; it is elastic, but not so easily wrought as that of E. marginata. . . . Its strength in transverse strain is equal to English oak, while it is 50 per cent. stronger in regard to vertical crushing strain, according to tests made under the supervision of Mr. Laslett. Admirable for wood-bricks, even in cold climes." Maiden gives the same uses for the timber. Karri, Jarrah, and Djatti wood are the three kinds imported by the Natal Government for railway sleepers, but the Karri will probably not

prove durable; while concerning its use for harbour works the Engineer of the Natal Harbour Department reports:—"Karri (E. diversicolor) is quickly eaten up below water, but above water it is equally good if not better than Jarrah," and again writing concerning Ironwood (Olea laurifolia) he states that the latter "cannot, however, be compared for constructing timber wharfage either for resisting the sea-worm with Jarrah, or for durability with Karri above water." Laslett says:—"It will not last between wind and earth, though, as far as is yet known, it resists the action of water." Probably often sold as Jarrah, and being of the same light-red colour not easily distinguished except by the ash left after burning, which is of different colour, being nearly white, while that of Jarrah is black.

EUCALYPTUS EUGENIOIDES, SIEBER.

WHITE STRINGYBARK-TREE.

An erect unbranched tree which grows freely and reproduces itself within the mist belts, though also hardy enough for any part of Natal. The seedlings have alternate leaves and are hairy, like those of the closely allied E. capitellata, Sm. The timber has valuable qualities, but is not durable in the ground.

EUCALYPTUS FICIFOLIA, F. V. M.

CRIMSON-FLOWERED GUM.

Rather a small tree, seldom over 30 feet in height, and not recommended as a timber tree, but on account of its gorgeous crimson flowers, abundantly produced even on young trees, and which render this species one of the brightest ornamental features in a landscape. It has large fruits similar to those of E. calophylla, to which it is closely related. Both these species come from the semi-coast regions of South West Australia, where they are accustomed to heavy winter rainfall, consequently the climatic conditions here are reversed for them. They do well in the winter rainfall of Cape Town, and fairly well even in the summer rainfall of the Eastern Province, but in Natal only one poor tree of E. ficifolia is known to me.

EUCALYPTUS GLOBULUS, LA BILL.

TASMANIAN BLUE-GUM.

The timber value of this species was dealt with in Chapter XIII. In the case of Mr. Raubenheimer's trees, recorded therein, the crop was obtained from seeds sown where they were to remain and watered until germination was secured, and a start made. That was in Cape Colony, but a similar treatment was adopted in Natal on the beautiful estate of Hon. Jos. Baynes, M.L.C., at Nel's Rust, where this and other species of Eucalypts were sown along the south side of a long soil bank having an irrigation furrow close at hand, and with successful result. On the same estate some of the older trees, which are probably the best in Natal, are 200 feet in height and 30 inches diameter, while others with less height have greater girth. E. globulus enjoys best a cool equable climate, with abundant water supply; the water preferably should not be stagnant, but is best as soakage from a perpetual stream; the species, however, succeeds best on any deep soil, even without irrigation, but fails in the humid coast districts both in Natal and in India. Its power of transpiration is very great, and it has been employed in many parts of the world to dry up what were formerly malarial swamps. Its extended culture cannot be recommended, in view of the varying results obtained, and the many valuable species now available.

EUCALYPTUS GOMPHOCEPHALA, DE CAND.

THE TOOART.

A large tree from South West Australia, where it enjoys winter rainfall and calcareous coast soil. On the barren drift-sands of Port Elizabeth, and on the dunes at East London, it has made more successful growth than any other gum; and in the Town Bush Valley, Maritzburg, the only tree seen in Natal is a fine specimen, 70 feet high, 23 years old. The timber is recommended for great strength and toughness, and is said to be durable. For the coast this species has high qualifications where rainfall is more or less regular, and even for the Zululand coast it is at least well worth trial.

EUCALYPTUS GONIOCALYX, F. V. M.

BASTARD BOX-TREE.

A rare tree in Natal, but one which should do well, especially towards the coast. Furnishes durable sleeper timber, valuable also for wagon-work and general purposes.

EUCALYPTUS GUNNII, J. HOOKER.

CIDER GUM.

One of the very hardy species, enduring hard dry frosts better than most. It makes a tall clean-stemmed tree, with abundant dark-green wavy foliage, and is consequently a good feature in upland ornamental tree planting. Mueller states it "supplies a strong useful timber," but its durability is doubtful, so it is not recommended for use as a post in the ground. Frequent in Kaffraria and not uncommon in Natal, usually doing well. It is a prominent feature in the main avenue at Cedara.

EUCALYPTUS HEMIPHLOIA, F. V. M.

GREY BOX.

A tall tree of fairly rapid growth and rather sparse foliage. Frequent in Natal, where it does well, as might be expected, since it comes from a similar climate. Does well also in Kaffraria, especially in or near the Yellow-wood belt and coastward. Mueller states:—"Regarded as a timber tree of great excellence. It is famous for the hardness and toughness of its timber, which is used for railway-sleepers, telegraph poles, shafts, spokes, mauls, plough-beams, and similar utensils; also excellent for fuel." Gill says:—"A most valuable timber, dense, hard, and of great strength, with close interlocked grain; it is admirably suited for many and varied uses, such as naves, felloes, shafts, spokes, railway-sleepers, fence posts and rails, and mauls. When seasoned, weighs from 60 to 70 lbs. per cubic foot." Maiden states:—"It is used in the Colonies for the naves of wheels and heavy framing, and for the cogs of wheels, large screws, mauls, handles, shafts, poles of drays, etc., which require a tough wood for their manufacture. In Victoria it is in high repute for railway-sleepers, and in that Colony and our own for piles, girders, etc. It can be recommended with confidence to railway-carriage builders and others who require a strong durable timber for framing, etc."

Messrs. Merryweather and Sons, wagon-builders, Pietermaritzburg, supplied for identification flowering specimens of this as a gum, which, they state, gives splendid useful timber.

EUCALYPTUS LEUCOXYLON, F. V. M.

SOUTH AUSTRALIAN BLUE GUM.

A frequent tree both in Kaffraria and in Natal, doing well in each, from the coast to between 4,000 and 5,000 feet altitude. Easily cultivated, but apt to lie flat on the ground

during the first year, a coppice shoot then taking the permanent lead. This species and E. sideroxylon were formerly regarded as forms of one species, and records regarding the timber include both forms together. The high value for strength, hardness and durability of E. sideroxylon is well known even in Natal, but from Australian advices it would appear that E. leucoxylon is equally valuable for wagon-wood, railway-sleepers, and underground mining work. A safe tree to grow on almost all soils, and in most localities in Natal, though not of so rapid a growth as E. sideroxylon.

EUCALYPTUS LONGIFOLA, LINK.

WOOLLY-BUTT.

Rather a slow growing tree, of ornamental pyramidal shape, and profuse white bloom; only a small tree on shallow soils, but occasionally doing well on deep alluvial soil. Common in Natal; some trees on Mr. Topham's estate at Umsindusi are 80 feet high and 12 inches diameter, with clean, upright, unbranched trunks; others near the coast at Ottawa on cold clay are almost as good as E. tereticornis of same age. Coming from Eastern Australia it should naturally succeed here; it also does fairly well both in the Eastern and Western Provinces of Cape Colony.

EUCALYPTUS MACRORHYNCHA, F. V. M.

VICTORIAN STRINGY-BARK.

Grows rapidly into clean straight poles, producing strong easily split timber, not, however, very durable in the ground. It grows well in Natal and Kaffraria, and can be recommended for ornament and shelter purposes, but less where durable timber is desired.

EUCALYPTUS MACULATA, HOOKER.

SPOTTED GUM.

A tall tree, branched upward, well adapted for cultivation in the lower parts of Natal, but seldom seen there. Does well at King William's Town. The timber is recommended for waggon-work, cart shafts, ship-building, etc., and is said to be durable and easily split

EUCALYPTUS MARGINATA, DON.

JARRAH.

Coming from near the south coast of West Australia, where it gets winter rainfall and hot summers, this species is naturally not in its proper habitat in Natal with its dry winters and showery summers. And its behaviour shows that the climate does not suit it, for though trees have been repeatedly tried I have not yet seen a tree of more age than a few years. In Kaffraria the same result was experienced, trees doing well for a few years, but gradually dying out without apparent cause. In the neighbourhood of Cape Town, where climatic conditions resemble those of its native habitat, it is said to be doing well, but in California McClatchie writes:—"In California the Jarrah does not thrive at or near the coast. In interior valleys having moderate aridity and heat it does some better, but at no point in America where it has been set does it grow with sufficient rapidity and vigour to warrant planting it for commercial purposes."

Jarrah is considered one of the most durable of timbers, both for railway and harbour work, and it is largely imported for these purposes, but it is one which cannot reasonably be expected to succeed in Natal, where other equally durable timbers, which do succeed, such as the Ironbarks, will have to take its place when the present West Australian supply becomes exhausted. At the Railway Nursery at Inchanga Jarrah mostly dies out before it gets past the nursery stage.

EUCALYPTUS MELLIODORA, A. CUNN.

YELLOW BOX.

A slow growing rather bushy tree, giving a distinct feature in ornamental planting, but not suitable for culture for timber. In East Australia, where it is indigenous and of good size, it is considered a valuable timber, but other kinds are better adapted for timber-culture here.

EUCALYPTUS MICROCORYS, F. V. M.

TALLOW-WOOD.

Not grown in Natal meantime, so far as I know, but climatically adapted for growth, and of considerable timber value. The timber is of a greasy nature, it is consequently waterproof, and durable in the ground. Mueller states:—

"The timber is hard, durable even underground, and is employed for railway sleepers, wheelwrights' work, knees and breast-hooks in ship-building; used with advantage and preferentially for wood-bricks in the City of Sydney; the young trees serve for telegraph poles." Maiden supports this, saying:—"One of the least liable to shrink of all our hard-woods. It is heavy, strong, and durable. It may be planed and turned with great satisfaction. It is not easily split, the greasy substance contained in it making it a tedious matter to get the wedge to 'draw.' I would express the opinion that after Ironbarks, Tallow-wood is the most valuable of our hard-woods."

EUCALYPTUS MICROTHECA, F. V. M.

THE COOLIBAH.

Another species not yet tried in Natal, but, as it belongs to the hot dry deserts of the interior of Australia, it is at least worth trial in similar localities here. Timber used for furniture, piles, bridges, and railway-sleepers.

EUCALYPTUS OBLIQUA, L'HER.

TASMANIAN STRINGY-BARK.

A tree of easy culture in Natal, growing to a large size quickly. Like other Stringy-barks, the timber of this kind has high technical value for work where durability in the ground is not required; it is straight and splits easily, and where naturally abundant grows to an enormous size, and is used for a vast variety of purposes, including piles and sleepers. The growth of this species for these purposes cannot, however, be recommended, especially where other more durable and equally valuable kinds can be grown as easily, but for ornamental purposes and the production of timber for indoor work it is suitable.

Concerning its timber the following remarks by Mr. J. H. Maiden are of interest:—"That from New South Wales localities is a rather inferior, coarse, open-grained, porous wood, liable to shrink and warp. It is not esteemed for public works in New South Wales. Its open nature may be, at least in part, a consequence of rapid growth, for which, according to several authorities, E. obliqua has the reputation. It has been used in the Braidwood and Cooma districts for many years for building purposes. In Victoria and Tasmania it is largely used, and a recent official publication of

the latter State says:—'It is our most valuable wood.' In considering the value of this observation, it should, of course, be borne in mind that neither of these States possesses a series of excellent timbers such as New South Wales can boast of. At the same time it is quite possible that Tasmanian and Victorian grown timbers of this species are superior to that grown in New South Wales. Howitt, a leading Victorian authority, groups it as a 'second-class timber,' adding that 'although a fairly durable and useful timber, it has generally the fault of being more or less full of gum-veins, and is thus unsuitable for many purposes.'"

EUCALYPTUS OCCIDENTALIS, ENDL.

FLAT-TOPPED YATE.

Not seen in Natal, but in Kaffraria trees on deep alluvial near King William's Town were 60 feet high and 12 inches diameter in ten years, while at Fort Cunynghame on shallow sandy mountain soil the growth was miserable, and the tendency to flower early very pronounced. Mueller states:—"The timber is hard and strong, thus sought by wheelwrights, and probably as valuable as that of E. cornuta (the ordinary Yate), to which it is closely allied." Worth trial in lower Natal, especially if this species is correctly identified as the source of the *Mallet bark*, now being imported from West Australia to Europe as a tan-bark, and said to be available in quantity.

On deep alluvial land this may be more valuable than Black Wattle, but on shallow soil it is not likely to produce a ton of bark per acre in 50 years.*

EUCALYPTUS ODORATA, BEHR.

ONE OF THE BOX-TREES.

This species is closely allied to E. melliodora and also to E. hemiphloia; it grows more rapidly and larger than the former, and less rapidly and smaller than the second. There are several large old trees of it in Natal, and in Cape Colony there are many at Cathcart, all good trees, but inclined to branch where widely planted.

In Australia it is said to occur on limestone as well as on clay, and to have hard very durable timber, used for sleepers, posts, and piles.

---

*See Chapter on Mallet Bark at end of this Bulletin, written from later information than above.

EUCALYPTUS PANICULATA, SMITH.

WHITE OR GREY IRONBARK.

Concerning the value of different Ironbark timbers, see notes under E. crebra. That of E. paniculata is placed first in importance by Maiden, who also states:—"It is to White Ironbark of good quality that all the encomiums which have passed on Ironbark may be attributed. At the same time, timber but little inferior may be produced by some of the other Ironbarks." Mueller says:—"It furnishes a hard durable wood, excellent for railway sleepers. It is also much used for building and fencing, as it is lasting underground.' This species, in addition to the above common names, is also sometimes known as "Red Ironbark," a name more usually given to E. sideroxylon. In both species red timber is not an unusual colour, though in E. paniculata there are forms having white or grey timber. E. paniculata grows freely in alluvial or deep land in Natal, especially in the Middle and Coast Districts, but on poor and shallow soil it becomes of less size, while in Australia it has a tendency on such soil to become a Mallee scrub, and is then without value. On proper soil, however, it is one of the most valuable timbers to grow in Natal, and as it is easily grown, being hardy and good at enduring difficulties in its nursery stages as well as afterwards, this is one of the species which should be most extensively cultivated, where sleepers or other lasting timbers are in demand. It is meantime the favourite gum on the North Coast, where the local name of Torr Vale Gum has come into use for it; it does well even on shale ridges, but naturally makes most rapid and clean growth when given alluvial soil.

EUCALYPTUS PAUCIFLORA, SIEBER.

One of the most hardy Eucalypts, growing freely in exposed situations in the Orange River Colony, and at Hanover, Dordrecht, etc., in Cape Colony. In Natal only poor specimens near Maritzburg have been noticed. It is naturally a small tree, with comparative worthless timber, but it endures where no other Eucalpyt does, and consequently has a value for certain situations. In Natal better kinds can usually be substituted. E. coriacea, A.C., is a synomym.

EUCALYPTUS PILULARIS, SMITH.

THE BLACK BUTT.

An ornamental and useful species, growing eventually into a very large tree. Many fine specimens occur in Natal, usually as single trees, and consequently much branched.

Trees at the Hilton Road Wattle Plantation 10 years old are 60 feet high, and have clean straight boles 12 inches diameter. Those at Wilkinson's Nursery are enormous trees in 16 years' growth. It is the fastest growing Eucalypt at Tokai, near Capetown, making 60 feet height in five years. The foliage is usually horizontal and ample, making it a good shade tree. It belongs naturally to the humid regions near the coast of Eastern and Southern Australia, and enjoys heavy summer rainfall. When young it is liable to damage by frost, and in after years suffers if in dry shallow soil, or above an iron pan. At East London it failed on the sands of the coast dunes, and in various situations has shown that its requirements need attention, but that it does well where conditions are satisfactory. Maiden states:—"This is one of the best hardwoods we have for house or shipbuilding. It is useful for bridge planking, though inferior to Tallowwood for that purpose. It has been tested for many years for blocks for wood-paving, with most satisfactory results; in fact it is one of the best timbers we have for the purpose, both as regards wear and durability. It takes tar well. After Ironbark, I would only place this timber second to Tallowwood, amongst our hardwoods, for general purposes."

Mueller says:—"Timber much used for flooring-boards, also for railway-sleepers and telegraph poles, and for wood-bricks in street paving in Sydney. Weight of a cubic foot of absolutely dry wood from 50 to 56 lbs."

EUCALYPTUS PIPERITA, SMITH.

PEPPERMINT STRINGY-BARK.

A tall, mostly unbranched tree, not common in Natal. Like the other Stringy-bark trees, its timber is not durable in the ground, so its culture can only be recommended for ornamental purposes, or for indoor timber.

EUCALYPTUS POLYANTHEMA, SCH.

THE RED BOX, OR DEN-TREE.

Usually a medium-sized much-branched tree with abundant foliage, and consequently a suitable tree for street tree-planting, but if closely grown or trimmed up, it makes a good clean stem of fair height and fairly rapid growth. It continues to keep alive in very dry and unpromising situations, but it responds readily to good soil and abundant moisture. Mueller states:—"A tree attaining a height of 150 feet; it furnishes an extremely hard and lasting timber, in

great demand for mining purposes and railway-sleepers; also for wheelwrights' work. For fuel this wood is unsurpassed. It is extremely strong, excelling oak and ash, surpassed among Eucalypts in transverse strength, according to our experiments, only by E. leucoxylon and E. siderophloia."

For economic purposes its growth in Natal is too slow, except on good deep land.

EUCALYPTUS PUNCTATA, D.C.

LEATHER-JACKET.

A tree of large size and rapid growth in the Midlands, but rather apt to produce heavy branches when widely spaced. Closely allied to, and not always easily distinguished from E. resinifera. Maiden speaks highly of its timber, and Mueller says:—"The wood is of a light-brown colour, hard, tough, and very durable; used for fence posts, railway-sleepers, wheelwrights' work, also for shipbuilding."

EUCALYPTUS RESINIFERA, SMITH.

RED MAHOGANY.

One of the most common and most rapid-growing Red-gums of Natal. It varies immensely, and may be said to merge gradually into several other species. It is only half-hardy, for it suffers much from the cold dry winters of the uplands, but delights in the mists and summer rains of Mid-Natal, and also does well towards the coast. As a single tree, this species usually does well, but in plantations it is so liable to occur in many varieties together (apparently hybrids), that a few strong plants usually dominate all their neighbours.

Authorities agree on the value and durability of the timber, though from local experience it would appear to me that the tree requires to be fully matured before its durability is developed. It grows rapidly into a large tree, often much branched. Mueller states:—"A superior timber-tree, of large size. Wood much prized for its strength and durability. Used in Sydney for wood-bricks, also particularly good for fuel." And Maiden adds:—"Of a rich red colour. Very durable, and becoming very hard with age, even as hard, or harder than Ironbark. Resistant to white ants, and does not discolour paint. For general building purposes and for fencing it is a very durable timber. It is an excellent timber for wood paving. . . . . Red Mahogany is often sold as Jarrah, which it closely resembles, and for which, I

believe, it is a perfect substitute. . . . . It is of a handsome colour, and works up well. It may be recommended for large turned work and for heavy furniture. It is useful for weather boards." Concerning its requirements, McClatchie states:—"The Red Mahogany grows quite well in the coast regions of California, but does not thrive in the dry interior valleys. It does not resist severe frost, nor does it endure high temperatures in a dry atmosphere. It is well suited to moist, semi-tropical climates, being confined in Australia almost exclusively to the warm coast districts."

EUCALYPTUS ROBUSTA, SMITH.

SWAMP MAHOGANY.

One of the most common and best known Gums near Durban and along the coast, where in moist soil, and even on banks through swamp it does well, producing a heavy dense dark-green foliage, but on light soil overlying shale it is usually a failure. Inland it is only successful on deep soil and in humid surroundings, but is not tender to frost, and there are a few fair trees high on the Drakensberg. It has a decided tendency in all unsuitable localities to flower and seed too freely at an early age, and practically stop growth there. In such cases self-sown seedlings are abundant, but are rather an endeavour to maintain life than an evidence that the species is successfully naturalised. The branches are rather brittle, and apt to be broken by wind. Mueller states: "The wood is remarkably durable, reckoned a fairly good timber for joists, also used for ship-building, wheelwrights' work, and many implements, for instance, such as mallets." Local experience hardly bears this out.

This species should do well in lower Zululand.

EUCALYPTUS ROSTRATA, SCHL.

RED GUM.

This, in its several forms, is the most widely distributed Gum in Australia; and in cultivation elsewhere it has shown the same adaptability to a wide range of situations. In Natal it occurs from the Coast to Van Reenen's and Newcastle, usually doing well, and it also succeeds well in many parts of the Transvaal, Orange River Colony, and Cape Colony. At Ottawa, Natal, trees 10 years old on poor worked out sugar land overlying clay are 70 feet high and 12 inches diameter, while at the Bacteriological Institute, near Maritzburg, there are trees 120 feet high with grand straight boles

18 inches diameter; and at Mr. Topham's, at Umsindusi, there are many trees 80 feet height and 15 inches diameter, with good clean stems. In the stiff clay and alluvial soil of Ladysmith, surrounded by kopjes, and with a dry hot atmosphere, E. rostrata is a perfect success, and so also in other parts of the rather bleak uplands. E. tereticornis is simply a form of E. rostrata, possessed of all its qualities, and differing most evidently in its heavier foliage and in its bud-form. E. Rostrata grows naturally on river flats in Australia, and so is one of the few species adapted for growing on flats away from the mountains in this Colony, though it succeeds on the mountains also.

Maiden, writing of its occurrence in New South Wales, says:—"It is the tree which produces directly to the Colony by far the most revenue of all our trees." In California it has been extensively planted, in very varied situations, and usually with success. Mueller is enthusiastic as to its value for innumerable purposes, but adds:—"It should be steamed or carefully seasoned before it is worked for planking. . . . This or any other timber can advantageously be covered with sawdust to prevent warping and cracking in exsiccation."

Gill states:—"The quality of the timber varies with the kind of habitat. That grown on hilly ground cannot be excelled, though somewhat lighter than that grown in rich, moist land, and, according to situation, the weight per cubic foot varies from 50 to 70 lbs. in seasoned timber. The colour is generally dark-red, hence its name; and though sometimes hard it is more easily worked than any other gum. It is admirably adapted for a great variety of uses, either above or under ground, or in water. As fencing posts it will last 30 years and even more, standing unrivalled for this purpose; nor can it be excelled for piles or railway-sleepers when of the best quality, and it resists well both the white ant and the teredo. For shipbuilding, house, and wagon work it is well suited, and also for many minor uses, amongst which it may be noted that it is much preferred for bullock yokes, as it wears smooth without splintering. As a timber for furniture, especially veneers, selected pieces are admirably fitted, the mottled and wavy figure often met with being singularly beautiful; when very dark in colour it frequently resembles the best mahogany. It also makes good blocks for street paving, and an excellent material for parquet flooring. Single trees when felled and converted into sleepers have occasionally produced as many as 100, 220, and even 250 sleepers of the dimensions of 6 feet 6 inches by 8 inches by 4½ inches. Altogether this is one of the most desirable species to grow on a commerical scale in Natal. Hutchins says concerning it:—"It is thus a tree that rejoices in extremes of heat and cold, no great elevation, a rich soil, and alterations of moisture and draught. Unsifted seed averages about 25,000 to the ounce.

EUCALYPTUS SALIGNA, SMITH.

A tree of large size producing timber of first quality, great strength and durability, used for piles, beams, sleepers, building purposes, etc. Resembles Karri in its clean white stems and horizontal foliage, but is more closely connected with E. botryoides, with which it is often confused. Not extensively grown in Natal, but there are beautiful trees at Nel's Rust about 22 years old over 100 feet in height by 14 inches diameter. It is best adapted for the Midland and coastward districts, and should be largely cultivated. It has too many Australian names.

EUCALYPTUS SIDEROPHLOIA, BENTH.

BROAD-LEAVED IRON-BARK.

A large tree of fairly rapid growth, and, like the other Iron-barks, of first importance as a timber-tree. Scarce in Natal, though the specimens seen are doing well. Mueller states: "According to the Rev. Dr. Woolls this furnishes one of the strongest and most durable timbers of New South Wales; with great advantage used for railway-sleepers, jetty-piles, and for many building purposes. It is likewise highly appreciated by wheelwrights, especially for spokes; also well adapted for tool-handles and various implements. Found by us to be even stronger than hickory, and only rivalled by E. leucoxylon. It is still harder than the wood of E. leucoxylon, but for this reason worked with more difficulty."

Maiden places it third in quality among the Iron-barks.

Mr. A. Sclanders writing from Kelvin, Little Tugela, altitude about 4,000 feet above the sea, sends specimens which are easily identified as E. siderophola, and states:—',The trees from which I obtained the above were planted in 1886, and are now about 70 or 80 feet high, with a diameter of about 8 inches. They are comparatively slow-growing; some other Eucalypti—E. robusta, E. globulus, E. amygdalina, etc.—growing alongside and planted same time are four times the size. We have cut down several E. siderophloias, and have found them magnificent timber for disselbooms in wagons, carts, etc., or wherever great strength is required. A neighbouring wagon maker told me it was the finest wood he had ever used for disselbooms, and for that purpose was equal to Hickory or Ironwood (Olea laurifolia). I am so pleased with the tree that I have 1,000 planted, and intend planting another large area with them."

EUCALYPTUS SIDEROXYLON, A. CUNN.
RED IRON-BARK.

The best known and usually the most successful Iron-bark in Natal and Eastern Cape Colony. Easily known by its rugged, deeply fissured, nearly black bark, veined with kino, and its large seed-vessels, usually set in threes. Formerly confused with, or included in, E. leucoxylon, but easily distinguished by its bark as well as by the leaves of seedling plants, which are narrow and alternate, and resemble those of mature trees, while in E. leucoxylon the leaves of seedlings are opposite and cordate. E. sideroxylon grows in almost all kinds of Natal situations, for though it responds well to moisture and good deep soil, it still continues to live on ironstone gravel and shallow shale and on thorn-veld, when other kinds have died out. While best in the Midlands and on the Berg, it also does fairly well on the upland flats, and also on the coast. Its timber, which is deep-red, and splits easily, is of the highest quality and durability, and is well known in Natal and Cape Colony, where a better opinion prevails regarding it than is expressed by Maiden, who, in placing it fourth among the Iron-barks, says:—"The wood of this is the deepest in colour, and also the softest and least valuable of the Iron-barks. The tree is often pipy and gnarled, but in some places (*e.g.*, the Mudgee District) it is a fine timber tree. Where one of the other Iron-barks is available, this Iron-bark suffers by comparison; nevertheless, it is a useful timber, and is employed in public works for such purposes as railway-sleepers and posts, where long lengths are necessary. Frequently good lengths cannot be obtained, and if they could, the tensile strength of this timber is not equal to that of the best Iron-bark. . . . . Red Iron-bark is found principally in the auriferous districts of the western and south-western interior. It is generally found on poor, sterile ranges, and is usually unaccompanied by any other species of Iron-bark."

In Natal good lengths of clean well-grown stem are not uncommon. McClatchie says:—"In California it thrives in dry soil near the coast, and on the plains and hillsides of many of the interior valleys. . . . . It has proved to be entirely unsuited to the hot interior valleys of California and Arizona."

It coppices freely, and I have seen a coppice shoot in ten years make a tree 15 inches diameter and 70 feet height.

EUCALYPTUS STUARTIANA, F. V. M.
APPLE-SCENTED GUM.

Most easily known in its seedling state, when it somewhat resembles Blue Gum (E. globulus), though in later life it is

more like E. viminalis, but with stringy-bark. It succeeds in the Midlands of Natal, and is also fairly hardy, trees in Barkly East doing well where other Gums died out, except E. viminalis and E. pauciflora. It usually forms a branched tree, and as the timber is of doubtful durability, it can only be recommended for landscape effect, though Mueller states that is is used for fencing and for fuel, and also for furniture manufacture.

EUCALYPTUS TERETICORNIS, SMITH.

FOREST RED-GUM.

Hardly distinguishable as a species from E. rostrata, though extreme varieties differ much. It has all the good timber qualities of E. rostrata; succeeds as well in all kinds of situations, and at various altitudes; usually has a denser foliage; and in some trying situations, as on the frosty flats at Whittlesea, Cape Colony, has stood undamaged while the ordinary forms of E. rostrata have been killed beside it. Highly recommended. Common throughout Natal from the coast to the mountains, and usually passed as E. rostrata. Mueller remarks:—"Much depends, as regards its durability, on the locality where it is obtained, and the manner of drying, a remark which applies also to many other Eucalypts."

Mr. Maiden reports a post of this timber that remained quite sound for 55 years; according to the same author, Mr. Howitt, the eminent authority on Victorian trees, places E. tereticornis at the head of all commercial timber trees of that Colony.

EUCALYPTUS VIMINALIS, LA BILL.

MANNA GUM.

In upland situations where Blue Gum (E. globulus) is beyond its natural range, E. viminalis is, without doubt, the most rapid growing tree obtainable, and as it keeps feathered to the ground for several years, and afterwards has a graceful drooping habit, and dark-green foliage, it is a great favourite for ornamental and shelter belts, where few other kinds will survive. In Johannesburg it has been largely planted with a view to being used for temporary props, etc. In the deep valleys of the Yellow-wood belt it produces grand clean trunks, but on more shallow soil and on shale ridges it is apt to form a branched spreading tree of low stature and of no timber value. Even when well grown the timber is not dur-

able in the ground, and less strong than many other Gums, consequently its timber value is low, though its timber-production is great. Even for fuel it is not recommended. Its chief value is for break-winds and shelter trees in cold frosty districts, or for props of a temporary nature. In Australia in suitable situations it grows occasionally to 300 feet in height and 15 feet in diameter.

CHAPTER XV.

ARAUCARIAS AND KAURI PINE.

Of all the ornamental trees in cultivation, perhaps no small group is so largely used for producing striking scenic effect, especially in sub-tropical countries, as the genus Araucaria. It is not, however, confined to sub-tropical countries, for one species, A. imbricata, has been in cultivation in England since 1796, and is now widely cultivated, while its home in Chili is near the snowline. The more tender kinds are, however, better suited for the climate of Natal, and have proved themselves at home in it; and as the more coastward parts of the Colony are found not well adapted for ordinary pine trees, and these Araucarias are the most likely substitutes for them for timber purposes, the following notes are supplied with a view to giving encouragement to the planting of kinds found suitable, and warning with regard to the others.

The natural habit of all the Araucarias is to produce a more or less distinct whorl of branches once a year, with a season's growth of clear stem in each case separating these whorls. This gives the tree a regular and formal appearance, which, combined with its graceful outline, places it easily as the best tree for a central single specimen on a lawn or other open space in which there is room enough to show its form to advantage. For twenty or thirty years it maintains its graceful individuality, when in good health, but beyond that age it is apt to lose the lower branches and become less graceful. On the coast the tender kinds have the further qualification of standing coast winds, resisting the attacks of white ant, and growing to maturity better than almost any other class of exotic timber trees, while in economic value as timber producers they bring with them first rate recommendations from their natural habitats, which there is every reason to expect will be found justified here when there are trees to spare for cutting up. The difficulty in getting up stock has hitherto been the scarcity of locally grown seed, and the poor germination usually obtained with imported seed, in many cases less than one in a thousand germinating. This is now being overcome to a considerable extent from the crops yielded of several kinds by the oldest trees in the Durban Botanic Garden, seedlings in thousands being produced from these. Many trees of several of the species are doing well throughout lower Natal, but most of these are less than 20 years of age. The trees in the Durban Botanic Garden are among the oldest in

the Colony, and therefore are of special value as showing what may be expected of each kind when more matured, though, of course, the number of old trees is small. Mr. J. Medley Wood, A.L.S., the Director of that Garden, in his last annual report, gives interesting information concerning the local growth of the different species, and remarks generally:—"In my annual report for 1899 I noted that the largest trees of Araucaria excelsa, which were planted in 1867, and are now, therefore, 35 years old, were dying out from the top; these trees still show signs of life, but are very gradually dying, while trees of A. Cunninghamii, A. Bidwillii, and A. Cookii planted at the same time and in close proximity to A. excelsa are still vigorous. Of these I prefer the two last named, as they seem to be more suited to the Colony, or, at any rate, to our part of it than A. excelsa, and A. Cunninghamii seems to be more subject to blight than the others. From what I have seen of them I can safely recommend them, specially A. Bidwillii and A. Cookii, as suitable to grow for timber."

The species in cultivation are:—

1. Araucaria Bidwillii, Hook; the *Bunya-bunya* (Fig. 49). This species, which is a native of the mountains of Queensland, in the neighbourhood of Brisbane and Moreton Bay, latitude 25 degs. to 28 degs. (equal to Swaziland), was introduced into England in 1840, but is not hardy enough to stand the winter there outdoors. Concerning its growth in Natal, Mr. Wood states:—"Our tree, which was planted in 1867, is now 60 feet in height, and 7 feet in girth at 6 feet from the ground, and is quite healthy. The late Baron Von Mueller says concerning it: 'A tree attaining 250 feet in height, with a fine-grained, hard, and durable wood, particularly valuable for furniture; it shows its beautiful streaks best when polished. The seeds are large and edible. Growth in height at Port Phillip 30 to 40 feet in 20 years, the big strobiles, ripening there.' Maiden, who is the recognised authority on Australian economic products, endorses the description of the wood, and adds a report as under by Ransome on a specimen sent to the Colonial and Indian Exhibition, viz.: This is a straight-grained, light-coloured, mild-working wood, often prettily marked. Judging by the experiments, it should make excellent framing, and as it plains well it could be used for common furniture, as it is not inclined to warp or twist." Maiden also states that it is not allowed by the Government to be felled on Crown Lands owing to its seed yielding an article of food to the Aborigines, who congregate from great distances to partake of the crop. Height, 100 to 150 feet; diameter, 30 to 48 inches. In the Cape Colony its culture is not regularly successful. In Natal it is frequent up to the Noodsberg, and usually doing well, though several of the oldest trees have died during the recent dry years, when of about 18 inches stem diameter. Around

Maritzburg it does well, and good specimens were also seen in Pretoria and Johannesburg.

2. Araucaria brasiliensis, Rich. From Southern Brazil, 15 degs. to 25 degs., and the Argentine Republic. A tree reaching a height of 180 feet in its native forests, where it grows in pure forests of the one kind. Its timber is used for boards, masts, spars, etc., and the bark yields turpentine. Several trees in Cape Colony have failed; its success here has still to be proved. Its failure appears to be due rather to drought than to cold. In Chili it reaches almost to the snow-line.

3. Araucaria Cookii, Brown (Figs. 39, 41, 69). From the Isle of Pines, New Caledonia, and the New Hebrides, latitude 15 degs. to 25 degs. Concerning this species Mr. Wood states:—"The tree of A. Cookii, planted at the same time as the others (1867), is now 90 feet in height and 6 feet in girth at 6 feet from the base." In the "Guide to the Garden" he states:—"In age this tree has a somewhat curious habit, shedding its branches for five-sixths or more of its length, replacing them by a smaller and more bushy growth, so that the tree at a distance presents a very columnar appearance, the resemblance being increased by the summit being crowned by a mass of foliage somewhat like a capital." Hence the name A. columnaris sometimes applied to it. Mueller gives its technical value as similar to A. excelsa, and its growth at Port Phillip at not quite 30 feet in 20 years., The growth recorded from Durban is nearly twice that, and many younger trees are doing well in Natal up to about 4,000 feet altitude. Probably the best species for planting in Coast districts, especially in Zululand. At the Empangeni Plantation, Zululand, there are now about 60 acres planted in this species, which will at least supply local seed for Natal use in the distant future. It does well up to Maritzburg, but was killed by frost in Dundee and Upper Tugela. Trees in the Cedara Nursery stood last winter almost without injury, but trees planted in the main avenue where there is a little more frost succumbed.

4. Araucaria Cunninghamii, Ait (Figs. 54, 74). The Moreton Bay Pine, from Queensland, New South Wales, and New Guinea. Cunningham, who first pointed out its difference from A. excelsa in 1824, states:—"On the coast of New South Wales it has a range of 900 miles between the parallels of 14 degs. and 29½ degs., but in no part, whether on the islands or in the offing, on many of which it is the only timber, or on the main shore, has it been remarked of large size, rather appearing of a stunted, irregular growth, and frequently broken down by the force of the prevailing winds. On the alluvial brushy banks, however, of the Brisbane River, between latitude 27 degs. and 30 degs., where it is perfectly sheltered from every blast, it rises to the height of from 100 to 130 feet, with a girth of from 14 to 16 feet, or even more; and such specimens are frequently to be met with having a

clear, smooth, cylindrical barrel, 80 feet in height from the ground to the lowest branches. In my several geographical excursions in the highly interesting country lying to the westward of Moreton Bay I met with this pine at some distance from the banks of the Brisbane River, as also on the hills on the western side of the dividing range, in latitude 28 degs., at a distance from the coast of about 80 miles, beyond which, however, in any inland or western direction it certainly does not exist. Its maximum, therefore, is evidently on the immediate coast, within the influence of the sea air, which, however, is not so essential to its existence as it appears to be for some of the plants I had discovered during Capt. King's voyage. Its wood is a pale yellowish deal, and is commonly used in house carpentry for making common furniture, and in boat building at Brisbane. In the green state its spars have been formed into masts for vessels of 200 tons, which are said to stand as long as the sap continues in them, but after they become dry they are not to be depended on." Mueller states: "The tree attains a height of 200 feet, with a trunk of 6 feet in diameter. Growth at Port Phillip 30 to 40 feet in 20 years. The timber is fine grained, strong and durable, if not exposed to alternately dry and wet influences; it is susceptible of a high polish, and thus competes with satinwood, and in some respects with birds-eye maple. Value in Brisbane, £2 15s. to £3 10s. per 1,000 superficial feet. The tree grows on the alluvial banks as well as on rugged mountains, overtopping all other trees. The resin which exudes from it has almost the transparency and whiteness of crystal, and is often pendent in the shape of icicles, which are sometimes 3 feet long and 6 to 12 inches broad." Ransome reported on the sample submitted to him:—"This is rather harder and better wood than the last mentioned (A. Bidwillii). It is of a light colour, with a straight grain, and planes very smooth with a rapid feed." Maiden mentions that the timber from the mountains is preferred to that from the coast flats; that it attains a height of 150 to 200 feet; diameter, 36 to 66 inches; that it yields spars 80 to 100 feet long, and that one tree has been known to yield 10,000 feet of timber. He says:—"It is pale coloured, and extensively used for flooring and lining-boards, also for punt bottoms when kept constantly wet." He gives the weight per cubic foot of dry timber as 30 to 33 lbs. On this species Mr. Wood remarks:—"Our tree planted at the same time as A. Bidwillii (1867) is now 90 feet in height and 5 feet in girth at 6 feet from the base." This is the tree of which an illustration will be found in Fig. 74. A good many younger trees are now growing in Natal, and trees have been planted for seed-bearers in the Empangeni Plantation.

5. Araucaria excelsa, R. Br. The Norfolk Island Pine (Fig. 69). This is the most widely known sub-tropical Araucaria, having been introduced into England in 1796, where it is largely employed for conservatory decoration; it is also

found capable of standing a certain amount of frost, down to a temperature of about 14 degs. Fahr. Its natural home is on Norfolk Island and on the Australian east coast, but it is now in cultivation in all suitable climates, though usually represented by only a few specimens on account of the difficulty of procuring seed. In Cape Colony fine trees are standing in Cape Town, Port Elizabeth, East London, Grahamstown, and Kingwilliamstown, the coast trees being fully exposed to the sea wind, though not near enough to receive sea spray. In Natal also good young trees are not uncommon. Mr. Wood remarks on the largest tree, 35 years old, beginning now to show signs of dying out, and adds:—"Our tree, planted at the same time as A. Bidwillii (1867), is now 80 feet in height and 3 feet 9 inches in girth at 5 feet from the base."

The first trees of this species, discovered by Captain Cook in New Caledonia, were on islands which are mere sand-banks. He found the timber white, close-grained, tough, and light, and the trees growing to 200 feet in height and 14 feet in girth. Some have since been found up to 30 feet girth, and clear of branches for 40 to 60 feet. Captain Hunter, who afterwards collected trial logs for navy purposes, found a large proportion of the trees defective, which, considering the exposure in which they grow, is hardly to be wondered at. He adds:—"It is a very short-grained and spongy kind of timber, and I think fit only for housebuilding, for which we know it to be very useful. When first cut down five out of six will sink in water; the wood is exceedingly heavy." (This evidently refers to fresh wood, as it becomes light when dry.) On this species Mueller remarks:—"A magnificent tree of unsurpassed symmetry, sometimes 220 feet high, with a stem attaining 10 feet in diameter, and with regular tiers of absolutely horizontal branches, one for each year. The timber is useful for shipbuilding and many other purposes. Growth in height at Port Phillip about 40 feet in twenty years. With A. Cunninghamii, amenable to almost any soil, except a saline one, and not subject to any disease. Endures also the vicissitudes of the clime of Lower Egypt, resists sea-breezes to a remarkable degree, ceases to be hardy in the south of New Zealand." Maiden mentions that enormous knots are sometimes produced on it, having most solid timber very suitable for ornamental turning.

6. Araucaria imbricata, Pav. *The Monkey Puzzle.* This species hails from the mountains of Southern Chili and Patagonia, between 36 degs. and 48 degs., and has for long been a favourite in England, where it stands well and forms a beautiful and striking item in park landscape. It is also being cultivated there now for its timber, which, according to Mueller, is "yellowish white, full of beautiful streaks, capable of being polished and worked with facility. It is admirably adapted for shipbuilding."

Its cultivation in South Africa has, however, been so regularly disappointing that it is well to warn against anything more than trial planting for a time. Perhaps this may be accounted for by its natural habits, which are thus stated in the Pinetum Danicum:—"A noble tree, growing 150 feet high, and indigenous to Southern Chili, where it is found on the western acclivities of the Andes, often reaching the snow-line, but never more than 2,000 feet below it. The roots are for a long period of the year covered with snow." In England, Scotland, and Denmark, where somewhat similar conditions prevail, it is successful, but here there are no such conditions, except perhaps in the higher kloofs of the Drakensberg, and even there drought is as often experienced as snow during winter. Mueller states that it grows more slowly in Australia than the native species. Some specimens in Johannesburg have continued to grow, though rather slowly.

7. Araucaria Rulei, F.V.M., from New Caledonia, is also included in the list cultivated in the Durban Botanic Garden, but thus far is not so well known as the others.

Cultivation.—Apart from A. imbricata and A. brasiliensis, which can hardly be recommended for extensive planting, there are no trees likely to prove of so much economic value on the Natal Coast as these Araucarias. They all like open, deep soil, tending to be sandy, but fail upon shallow shale formation and in tidal mud. They also do badly on a cold clay subsoil. They are safe on most situations up to about 4,000 feet altitude, though, of course, low frosty ground is to be avoided. They show their beauty best when grown as single specimens, but if cultivated for timber planting at, say, 20 feet apart, with a lower-growing undergrowth between, is what can be recommended, pending further trial.

Wood says:—"We have a large number of plants of all of these trees except A. excelsa, and it is to be regretted that more of them have not been planted, especially in the coast districts, and it is quite possible that in a soil more humid than that of the Botanic Gardens they might succeed even better than they have done with us."

Mueller says:—"Araucarias should be planted by the million in fever regions of tropical countries for hygenic purposes, on account of their antiseptic exhalations." Araucarias are subject to attack by several insect pests, two of which are described and figured, and treatment advised, in the first Report of the Government Entomologist, 1899-1900, page 106.

THE KAURI PINE.

AGATHIS AUSTRALIS ST. (DAMMARA AUSTRALIS, LAMB.)

(Figs. 37, 54.)

This magnificent tree, related to the Araucarias, is one of the few from New Zealand which have occasionally done well

in South Africa as scattered specimens, and promise to be worth extended cultivation in selected localities. In general appearance it does not closely resemble the pines or other coniferae, the leathery leaves being something like, though larger than, those produced on young saplings of Yellowwood (Podocarpus). It is still rare here, that shown in the illustration being perhaps the largest and oldest. This one stands in the Botanic Garden, Durban; is 80 feet in height, 5 feet in circumference, and is probably about 35 years of age. Others occur in the Botanic Gardens, Pietermaritzburg; at Wilkinson's Nursery, Town Bush, Maritzburg; at Mr. Geikie's arboretum, Karkloof; at the Botanic Garden, Grahamstown, and elsewhere.

There are several species of Agathis, natives of New Zealand, north-east Australia, New Guinea, and the East Indian Islands. One of these, the East Indian A. alba, is represented in the Botanic Garden, Durban, by a tree 75 feet in height, 3 feet 3 inches in circumference, while A. robusta (the Queensland Kauri) forms a large tree, yielding useful timber, of which Mueller records 12,000 feet (superficial) as having been cut from one tree.

The New Zealand Kauri (A. australis) is, however, the most important species of the genus, being regarded as yielding the most valuable timber in that Colony for building purposes, while it also attains the largest size among New Zealand trees, several giants being mentioned by Kirk as 22 to 24 feet in diameter, while 4 to 12 feet in diameter is given as the usual size. In height it runs to about 150 feet. Kirk states (Flora of New Zealand):—"The Kauri frequently grows in rocky or broken situations, and usually forms clumps or groves mixed with other trees. Although it is often the prevailing tree in extensive forests, it is comparatively seldom that it occupies large areas to the exclusion of other trees. . . . . It is a lowland tree, becoming rare at elevations exceeding 1,500 feet, although solitary specimens were observed on the slopes of Mount Wynyard at 2,500 feet, or perhaps higher."

It is found mostly in the North Island, whence enormous quantities of timber have been extracted, much of which is shipped to Australia, and Mueller mentions that Auckland alone exports about £100,000 worth of Kauri timber annually. It is, however, fast becoming worked out there, and large areas are now clear of it where formerly it abounded. In addition to the timber the semi-fossil resin found where Kauri has grown is an important article of commerce, 30,498 tons of Kauri gum, valued at £1,598,606, having been exported during the five years 1883-1887.

Authorities agree as to the value of the tree, which is thus stated in "Veich's Manual of the Coniferae":—"The Kauri pine is the monarch of the New Zealand forest; no other timber tree in the Colony is applied to so many and varied uses, and its resinous products are scarcely surpassed in value by

those of any other coniferous tree. Kauri timber varies in colour from yellowish white to brown; it is firm, straight in grain and of great strength, durability, and elasticity. It is used for every purpose for which timber is in request; for building, heavy framework, weather boarding, bridges, railway ties, telegraph posts, every description of joinery and decorative fittings both for public buildings and for private dwellings. The sapwood is excessively charged with resin, and possesses great heating power. Kauri gum is a semi-fossilised deposit, buried at a depth of five or six feet below the surface of the ground in tracts of open land in the northern island of New Zealand, where once grew Kauri forests which have long since disappeared. It is sometimes found in large lumps, but more frequently in fragments varying in size from that of a hen's egg to that of a man's head. It varies also in colour, being sometimes of a rich brown, sometimes bright amber-yellow, and occasionally almost colourless and translucent, revealing flies and small beetles that have been enclosed in it for ages. The clearest and most crystaline pieces are most valued; they are carved into ornaments scarcely to be distinguished from amber, but much more brittle; the inferior kinds are manufactured into varnish."

The huge trees referred to above are considered to be of great age, probably 500 to 800 years, and considerable variation in colour, density, and durability occurs, probably in accordance with the age of the tree or part in use. The timber is liable to warp somewhat, which is not surprising when used unseasoned, as is usually the case.

The Kauri is not likely to succeed except in the most moist parts of Natal, such as the Karkloof and along the coast, but the growth of the few trees in existence is quite satisfactory, and about as rapid as that of most pines or other conifers. It is a tree of striking habit, tall, erect, and unforked, with a tendency to lose its lower branches, and have its foliage mostly high up., The stem consequently yields long straight timber, suitable for masts, spars, etc., for which purpose its strength, lightness, elasticity and durability render it particularly suitable.

The tree is said to be white ant-proof, probably on account of its resinous nature, and the one difficulty in its culture is that seeds are not obtainable locally in quantity, though the tree illustrated has borne seeds, and plants have been raised from these. The fan palm shown beside the Kauri in the illustration is the native fan palm of Natal, Hyphaene crinita, Gaertn, known to the Natives as "Ilala," and abundant on the sandy hills near Port Shepstone and in Zululand. The Zulus use the fibre of this leaf for thread, the split leaf is used for making all kinds of basketware, milk dishes, aprons, etc., the seeds are cut into ornaments and earrings resembling ivory, and lately the custom of making palm wine from the crown has also come into use. The stems are occasionally ten or twelve feet long, but usually less.

Belis jaculifolia, Sal. (Cunninghamia sinensis, R. Br.) (Fig. 42) resembles Araucaria Bidwillii and A. brasiliensis in its general habit, but has its foliage more flattened in two rows. There are a few trees of this in Natal, making rather slow but ornamental growth, and it also occurs in Johannesburg, being more hardy than most of the Araucarias. It belongs to Southern China, grows slowly, never makes a large tree, and though its timber is said to be useful it is more an ornamental than a commercial timber tree. It is hardy enough to grow in favoured localities in England, and from a sample grown there Webster states that the timber is clean, firm, and of a desirable mahogany colour, and polishes nicely. He also states:—"It forms a handsome specimen, which for distinct appearance and beauty of foliage has few equals amongst coniferous trees. In no other conifer with which I am acquainted is there so diverse an appearance of foliage, the pleasant pale green of the younger foliage affording a striking contrast to the deep, almost yew-green of the older leaves." Natal specimens are not far enough on to show this.

CHAPTER XVI.

PINE TREES.

Pine timbers form such a large proportion of the timber demand of the whole world, and of any portion thereof, that it is upon the pine forest more than on all others that commercial extraction is telling most rapidly. Whole forest areas disappear, and even where they do not do so valuable constituents are worked out of them, leaving only a semblance of a forest actually of much less value than a newly planted plantation.

Even the Australian Colonies, while pushing hardwood exports, are purchasing a greater value of pine timber than they export of hardwood.

South Africa is not alone in having an enormous pine import, at least nine-tenths of the total timber import, and Natal maintains and requires its full proportion of this. But South Africa as a whole, and Natal in particular, is in the position of having no alternative, and being compelled to purchase these timbers because the indigenous forests do not supply a substitute, consequently the general exhaustion of the pine forests which is going on, places Natal in a worse position than other Colonies or countries which have some substitute available, and makes her subject to any increase in price which may accrue. Cape Colony has for years been preparing for a cosmopolitan pine-timber famine by laying down pine plantations within her own domain; during recent years about twelve tons of Cluster pine have been sown per annum, and in the earlier plantations around Cape Town and at Genadendal that species has reached the stage of being perfectly naturalised and sowing itself broadcast over these neighbourhoods.

Natal's tree planting has practically confined itself to Wattles and Gums, leaving out Pines and all other coniferous timbers except as ornamental garden plants.

In principle this is wrong. The main demand is for pine wood, the main supply should therefore be pine wood, if it can be grown. It has not been demonstrated that it cannot be grown; whatever has been done goes rather to prove that it can, although there has been no systematic work, and there is consequently no satisfactory proof. Single specimens exist throughout Natal, showing the ability of several species to live and thrive, what is required now is the laying down of test plantations in the various parts of the Colony, under forestal methods, on purpose to show that under these condi-

tions these species will do equally well, and prove remunerative as an investment. And in this the greatest difficulty, apart from Government plantations, is that no sufficient area is put down at one place to be worth erecting machinery for its conversion when mature, a difficulty which applies to Gums and other trees quite as much as to Pines. For instance, Pinus insignis was planted in some quantity years ago, and is now in many cases fit for cutting up into timber for fruit boxes and other boxes, of which class of material there is a large import from abroad, and for which purpose Pinus insignis timber answers admirably when not too knotty. But these trees are scattered all over the country, ten or twenty on a farm, and usually branched considerably, the result is that no one will take up an industry in this timber, knowing that the collection of logs to any central mill must kill any value that these logs do have.

Coniferous timber varies exceedingly according to species, and to a smaller extent, according to situation where it is grown. Not only the timber of the Pines, but also that of the Spruces, Cedars, Cypresses, Junipers, Araucarias, Cryptomerias, Sequoias, and many other groups are included as coniferous, as also the Kauri of New Zealand, and the Yellowwoods (Podocarpus),of which there are representatives in the indigenous forests here. From among these many distinct commercial classes of timber are produced, varying in utility and value, and also varying enormously in the conditions under which they can be grown. Generally speaking, however, they agree in producing reasonably light, easily worked timber, suitable for almost all domestic purposes, and much more in demand than the heavier and more difficult hardwoods. They may be broadly divided into Cedar-woods and Pine-woods, the former generally the more valuable but slower of growth, and more fastidious, and consequently not always the more profitable.

Pine timbers may be taken here as the product of the genus Pinus, in its widest interpretation, including Abies, Picea, and Pinus. In local experience of culture, however, this resolves itself into the latter group only, for the Spruces (Picea) and Silver Firs (Abies) have been proved failures, at least under all ordinary conditions, though there may be isolated spots in the Yellowwood forests where some species could be grown, and even high in the Drakensberg they may be successful. The most likely to succeed are Abies Smithiana and Abies Webbiana, both from the Himalayas; both endure the cover of other larger trees, and require more humidity than is usually obtainable here. So far as tried in Natal, or in Cape Colony, they have proved excessively slow, and no specimen has yet arrived at tree size. The Norway Spruce (Picea excelsa) and the Silver Fir (Abies pectinata) are even more slow, gradually dying out. Among Pines as the main centres of supply in other countries are situated in climates

differing considerably from that of Natal it is hardly to be expected that the kinds sent on the market from there would be successful here, and such has been found to be the case, but that does not exclude the successful use here of other species, some of which may not have even entered commercial life, through existing only in small quantity in their native habitats, through growing along with other kinds of more value locally, or through growing in districts where lumbering has not been taken up, or one of the many other causes which may interfere. Out of the many species available only a few have ever been tried here, and there is consequently a large field open for experimental culture of kinds the seeds of which are often not easily obtainable. The kinds which have been tried are as follows:—

PINUS INSIGNIS.—*Insignis Pine* (Figs. 75, 77, 78). It is in a measure unfortunate that this Pine was so widely distributed in Natal in preference to other species. Its vigour as a young tree led to extended cultivation and high hopes of its proving a permanent success, which unfortunately have not always been realised. That it does under certain conditions of deep soil and heavy mists succeed admirably only makes it the more tantalising that in many other localities it dies out completely before it is twenty years of age. On the Coast it has not been a success; in the Midlands it usually attains about 20 years of age, and 12 to 18 inches diameter, before it dies, and further up country where planted in the mist-belt, or in the moist Drakensberg neighbourhood, where winter rains or snows occur, it has seldom failed. In the Transvaal it is extensively planted, and in some of the plantations around Johannesburg it has made satisfactory forestal growth, though usually kept crowded too long, and therefore unable to develop timber. Coming from the coast of Northern California, where it is subject to winter rainfall and dry summer, it still maintains here the habit of starting into growth just as winter approaches, and suffering through the lack of moisture while its growth is yet immature. This led to the publication in the "Government Gazette" as long ago as February, 1893, of the following Government Notice (No. 94, 1893) by Mr. F. Schopflin, then Conservator of Forests for Natal:—

"PINUS INSIGNIS IN NATAL.

It is almost a common saying that the country of Natal offers conditions peculiarly favourable to the growing of all kinds of trees.

As far as experience goes one might be inclined to concur in the general opinion that the various and different climatic conditions in our mountainous Colony are admirably

suited to the successful introduction of a great number of exotic species. But that experience is very young still, and does not go further back than forty years at the utmost, and of most of the species now growing there are very few trees of more than about fifteen or twenty years' growth, such as the various conifers from America and British India, and amongst these the Californian Pinus Insignis. This tree has, within the last ten to fifteen years, found a great many friends in the Colony; and there are hardly any of the numerous plantations and parks in the surroundings of Pietermaritzburg which do not show numbers of it, mixed, either singly or in groups, with other exotic species.

It is all the more a matter for regret to see that the tree will not thrive here, and that, being planted chiefly for ornament and shelter, it refuses at an early age to serve either of the purposes.

My observations on the tree are briefly the following:—

1. The young plants generally present a healthy appearance, a perfectly developed system of roots, with one strong tap-root, and grow, when transplanted, without difficulty.
2. During the first years, especially in the alluvial soil on the river sides, the tree grows vigorously; but from about the fifth year, when it has attained a height of about fifteen to twenty feet, certain signs of irregularity in its organic development are observable.
3. That the youngest shoots often grow crooked instead of straight is indicative of an excessive vigour of growth, the result of which is, as a rule, an abnormal structure of the organic tissue, soft, and with little power of resistance against outside physical influence.
4. First, a great many of the terminal buds of the branches die, and the whorl of buds next to them begins to grow out and gradually to die as well, thus forming dense bunches of green and dry leaves; the top shoot of the last year, originally single, very often becomes dry, and one or several side branches of the whorl just below will take the lead, until, by degrees, they share the fate of their predecessor. As has been often observed, that portion of the crown which faces the north suffers first.
5. At the same time an abundant number of adventive leaves and shoots, from the older part of the stem, spring out in one year and generally die off the next.
6. Resin exudes from the bark of the stem and branches, generally from all the older parts of the tree, but, as a rule, more abundantly from

those parts of the stem where the boughs take their rise.

The whole tree presents by these marks an abnormal appearance, pointing to an internal disease, which has resulted in many cases in the death of the trees. Very often, after about the tenth year of growth, the trees that suffer most begin to die from the top, the more vigorous individuals resisting decay some years longer.

The disease is found equally in every part of the immediate surroundings of the City, whatever may be the soil and the locality.

As to the symptoms described above, no remarkable difference can be observed, whether the tree grows in the deep alluvial soil in the Town Bush, the Dorp Spruit, or the Umsindusi Valleys, or on the slopes of the Town Hill, the shallow ridge along the Richmond Road, or the dry and stony slopes near Fox Hill.

Of course a northerly aspect with dry and shallow soil is unfavourable for the growth of any tree, and in the case of Pinus Insignis it seems to accelerate early decay.

But whether the physical quality alone, or the mineral composition of the soil, which is in parts rich enough to satisfy the most extravagant wants of any species of tree, or any chemical substance in the soil or in the air that might be injurious to vegetable growth, can account for the disease, no insects nor fungi can be found that could primarily have injured the tree.

The wood presents a perfectly sound appearance, though it is very soft and almost useless for technical purposes.

I noticed large caterpillars (from a brown moth) which feed on the leaves of the English Oak, descending from a tree of Pinus Insignis in great number, but I was not able to ascertain any damage done to the foliage of that tree.

Even should certain insects or fungi have been found on the tree in isolated cases, there can be no doubt whatever that any injury done by them is of a secondary nature, and that the tree attacked had been suffering before.

There are certainly mechanical agencies which contribute to injure the Pinus Insignis more or less deeply, *e.g.*, an injudicious pruning or hail, either of which cause an increase of the exudation of resin from the wounds inflicted by them and thus add to the destructive effects of other agencies.

A lasting hailstorm may by its injury kill a young plant in the first or second year, but it could scarcely be fatal to a grown-up tree which, if otherwise healthy, would soon recover from the injuries sustained. Local damage by grass-fires cannot, of course, be here taken into consideration.

Nothing, therefore, remains but certain climatic conditions, that is, temperature and moisture in air and soil, to account for the general failure of the Pinus Insignis near Pietermaritzburg.

I do not hesitate to explain the symtoms of disease, described above, as the immediate results of these agencies, that is:—

1. The average high temperature of the air.
2. The great and sudden changes of the temperature within the twenty-four hours of the day.
3. The extremes of moisture and draught in air and soil during the different seasons of the year.

The mild climate of Natal is extremely favourable for the growth of young plants during the first two or three years after the germination of the seed; hence the healthy-looking and regularly-developed young plants of the Pinus Insignis.

As, however, the tree grows up, it becomes more and more affected under the influence of the local climatic conditions peculiar to this country, and considerably differing from those of its native country.

During the period of vegetation, in summer, the tree enjoys a high temperature and an abundance of moisture in soil and air.

The young parts of the tree which are formed during that period—that is, the soft and tender tissue of the terminal buds and shoots—are subsequently exposed to the drying sun and air of the long and rainless winter season. They lose, by continuous evaporation through the leaves, more moisture than they are able to replace from the soil through the action of the roots.

The consequence is the dying off of those young parts of the tree by excessive loss of water.

The fact that those terminal buds and shoots facing the north—that is, the direction of the sun—as a rule become dry first, confirms this explanation.

It is well known among physiologists, that, if the young shoots of these trees die off or are prevented by any outside influence from growing, others, growing from the nearest buds, will take their place.

In the case of the Pinus Insignis, this is shown (1) by the several top shoots, which, at first in a lateral position, will grow straight up, as soon as the original central shoot has become dry; and (2) by the whorls of terminal buds developing after the central bud has died.

If, in consequence of the repeated droughts, the foliage of the crown, that is, the entirety of the assimilating organs, has been reduced, a number of secondary buds grow out from the older parts of the stem in the wet season, in order, so to say, to make up for the loss and to restore harmony between the functions of the roots and the foliage.

I attribute the abundant exudation of resin from parts of the tree, which do not show apparent signs of mechanical injury from outside, to the mechanical action of the heat, which is able by its extraordinary increase and decrease during twenty-four hours to affect the volume of the wood to such

an extent that the bark and the young surface tissue of the wood will crack in places and allow the resin to exude from its channels to the surface.

That the resin appears more frequently at the base of the boughs seems to be caused by the varying density of the tissue of the wood in those parts of the stem, and consequently by its greater liability to suffer injury through the mechanical action of the heat.

To sum up, the foregoing remarks are intended to show that the growth of the Pinus Insignis under the influence of our local climate, especially its principal components, temperature, and moisture, is connected with continuous and periodical irregularities in the physiological functions, and leads to an early death of the tree. Mr. John Smith, of Fox Hill, informs me that in March, 1890, after some weeks of dry weather, a whole plantation containing 700 trees died within 10 days. It is quite natural that the trees growing on a dry stony slope, particularly exposed to the dry winds, will suffer more, and that the fatal result will be brought about sooner than in the case of deep soil and sheltered locality.

The Pinus Insignis is a native of California, where it is described as occurring in patches, local, and of limited extent. It would appear from the fact of the limited geographical extent of the country where the tree is found growing naturally that its capability to accommodate itself to other climates is particularly small. It grows there in the sandy soil near the sea coast; it is said to be the quickest growing conifer, and is held especially valuable as a tree for shelter and ornament, its wood being little used as timber.

Baron Von Mueller tells us that near Melbourne and Port Philip the tree has been planted with great success, and Mr. Fourcade recommends its being planted in Natal at an elvation of between 4,000 and 5,500 feet above sea level. In fact, considering the mean annual temperature, this altitude corresponds more to the climate of Central California and Melbourne, the former lying under 37 deg. north, the latter under 38 deg. south latitude, whilst Pietermaritzburg lies under 29½ deg. south latitude, and, being situated about 2,000 feet above sea, has a climate which practically differs but little from that of the subtropical Natal coast country.

After the disappointing experiences made with Pinus Insignis in the lower parts of Natal, it appears scarcely necessary to warn people against further cultivating this tree.

It is, however, probable that better results would be attained from plantations at higher altitudes.

The few specimens which may be growing at present in the higher parts of the Colony are probably too young to allow any reliable conclusion to be arrived at as to their future growth.

It is generally just as difficult to gauge the conditions of any local climate and its influences as to the growth of a

foreign species of tree, as it is to form a correct idea of the capability of such species to adapt itself to a foreign climate, before the matter has been practically tried. The only reliable answer, therefore, to the question as to whether exotics will thrive will be given by the results of systematic planting.

F. SCHOPFLIN,

Conservator of Forests."

Pietermaritzburg, 26th January, 1893."

On sending this report, together with further remarks, to Professor Hilgard, Director, University of California College of Agriculture, he has favoured me with the following remarks concerning Pinus insignis in that State, dated August 15th, 1903:—

"As to Pinus insignis, its original home on the bay of Monterey is in a deep very sandy soil, which drifts when the wind blows from the sea. This would seem to be the first point in which your soil probably differs radically from the choice of the tree. The next that strikes me is that while it succeeds well, even here, in quite heavy soil, it fails very generally in the hot interior, away from the seashore, and from no particular cause that is readily perceived; beginning to die from the top down. As many of our interior lands contain alkali salts these may in part account for their failure, but it is evident that the tree will not bear intense dry heat. The wood of the tree is not esteemed here, not being very durable, but all along the coast it is much used as a wind-break owing to its habit of retaining the lower branches through life."

Mr. A. V. Stubenrauch, of the same College, also wrote, December 17th, 1903:—"I have been making enquiry throughout our State regarding the longevity of the Monterey Pine, and find that it has the reputation of being short lived, especially in the interior where climatic conditions are similar to those mentioned by Mr. Schopflin as existing in parts of Natal. The tree does excellently, and is used to some extent even in the hot interior valleys for wind-breaks and roadside protection. When it reaches the age of about 20 or 25 years it begins 'to go back.' Here and there, however, there are some very fine specimens which do not show any indications of failing. On our University grounds here at Berkeley there are several specimens which are now about 30 years old, and still in a vigorous condition. In southern California, notably at Pasadena, where the climatic conditions are more extreme than at Berkeley, I have seen two specimens about 25 years old which are still in excellent condition. On the whole, however, the tree has not a good reputation among tree-planters where a long-lived tree is desired. The wood is not used for economic purposes. It is not durable; is brittle and brash, and, so far as I know, has never been sawn for timber purposes of any kind."

Sargent, in his Forest Flora of North America, says in respect to Pinus radiata (which is a synonym of P. insignis: —"Pinus radiata, which is most abundant and grows to its largest size on Point Pinos, south of the Bay of Monterey, inhabits a narrow strip of the California coast from Pescadero to the shores of San Simeon Bay, forming an interrupted forest extending inland from the summits of sea cliffs and the margins of beaches and sand dunes for a distance only of a few miles, and grows also in a peculiar form on the islands of Santa Rosa and Santa Cruz, of the Santa Barbara group, and on the Guadalupe island, off the coast of Lower California, on which great forests of this tree formerly existed at elevations between two and four thousand feet above sea-level.

"The wood of Pinus radiata is light, soft, not strong, brittle, and close-grained; it is light brown, with thick nearly white sapwood, and contains narrow conspicuous bands of small summer cells and inconspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.4574, a cubic foot weighing 28.50 pounds. Formerly occasionally manufactured into lumber, it is now only used as fuel.

"Pinus radiata was introduced into English gardens in 1833 by David Douglas, who found it near Monterey. The light green of its dense foliage, and its compact bushy habit while young, at once attracted the attention of planters; and one of the least beautiful of North American Pines as it grows naturally, it has been extensively used for the decoration of parks in western and southern Europe, where, although rather tender except in favourable positions, it has already attained a great size, and produced noble specimens, with wide-spreading lower branches, often resting on the ground, and shorter and erect upper branches forming dense masses of bright green foliage. Easily and cheaply raised from seed, and growing with remarkable rapidity, the Monterey pine has been more generally planted in the coast region of the Pacific States from Vancouver Island southward than any other conifer, with the exception of the Monterey Cypress, and it has been successfully introduced into the south-eastern States, Mexico, Australia, New Zealand, and other regions with temperate climates.

"The insular form of Pinus radiata, first discovered by Dr. Edward Palmer in 1875 on the island of Guadalupe, where it is a large tree usually about 70 feet high, with wide-spreading branches, differs only in the number of the leaves, which are usually produced in clusters of two, and sometimes on the same branch in clusters of two and of three, the cones appearing identical with those borne by the mainland tree. In June, 1888, this form was found on Santa Rosa by Mr. T. S. Bramdegee.

"Pinus radiata grows with great rapidity even in the most exposed positions, and on apparently barren soil. The log specimen in the Jesup collection of North American woods in

the American Museum of Natural History, New York, is 17¾ inches in diameter inside the bark, and 28 years old; the sapwood of this specimen is 6⅛ inches thick, with eighteen layers of annual growth. Many of the trees covering that part of Point Pinos, called Pacific Grove, had trunk diameters of 2 feet in 1888, when they were only from 20 to 30 years old; and the largest trees on this point, with trunks from four to six feet in diameter, are not more than one hundred years old, some of their layers of annual growth being an inch in thickness."

P. insignis has been planted largely in Cape Colony, but though it makes an enormous growth it has not been exempt from trouble there. The caterpillar of a large moth (Antheræa cytheræa) has defoliated large areas year after year until kept in check by its own parasitic enemies. At Tokai a fungus caused trouble, but this has not been reported elsewhere, and wherever it has been planted the tendency to die out early is noticeable. Writing on October 30, 1903, Mr. D. E. Hutchins, Conservator of Forests, Cape Town, says:—

"Monterey, from which presumably our Pinus insignis came, has a climate closely resembling that of the Cape Peninsula, and differing considerably from that of the Natal coast, hence presumably the failure of Pinus insignis on the Natal coast. Here it is doing better than it was. The trees attacked with the fungoid disease at Tokai were cut out and burned, and the disease has not spread. The caterpillars that were so bad at Ceres Road have disappeared. They did a good deal of damgae there, and I could not look on them as a blessing in disguise, as I notice you did at Fort Cunynghame."

The latter clause has reference to an expression of opinion that the caterpillars sometimes prevented the undue growth which usually resulted in failure.

Probably the best growth of Pinus insignis in Cape Colony has been at Hogsback Station, where mists and rains occur daily during summer, and snows are experienced every winter, but it has also made fairly good growth under irrigation in the excessively arid climate of Hanover, in the Karroo.

I have quoted freely concerning P. insignis in order to show that its frequent failure is only what might be expected. It is naturally a short-lived tree, it is naturally a coast tree, accustomed to winter rainfall, and it belongs naturally to drifting sand areas. That it succeeds so well as it does in so many and varied localities and climates indicates an elasticity of nature beyond that displayed by most of our other trees. But the question remains, is it worth cultivation? As a shelter and ornamental tree it distinctly is so, keeping in mind however, that only a short life is expected from it. This is the case with the Black Wattle, the Silver Wattle, the Saligna Wattle, and probably also with some of the Araucarias and many other of our highly ornamental trees, and still these continue to be grown for ornament and shelter; why not this?

But as a timber tree the condemnation extended to it is too sweeping. It makes as much timber in its 20 years of growth as the Scotch Pine or the Norway Spruce does in three times that period in Northern Europe, and though its timber quality is not first rate, it is still sufficiently high to make it quite suitable for boxes, cases, ceiling-boards, and rough planking. It may be urged why grow this when better can be grown, but that better material, whatever it may be, has still to be planted, and no better quality will be ready for felling within 20 years of this, if both are planted at the same time.

In my report for 1900 (Reports of Conservator of Forests, Cape Colony, page 96) I showed the annual increment of the various kinds in measured areas at Fort Cunynghame Plantation, Cape Colony, to be:—

	Age of increment area. Years.	Annual increment per acre. Cubic feet.
Pinus insignis	9·5	526
Pinus pinaster and other Pines except P. insignis	9·	203
Eucalypts.	10·75	152
Wattles (A. Mollissima)	7·	83
Other kinds, Oak, &c.	10·5	87

Mr. Hutchins gives the following statement of the yield in cubic feet, per acre, of timber plantations in Cape Colony:—

	Cubic Feet.
Tokai, Karri (Prince Kasteel)	625
Tokai, Karri (Cedar ridge)	533
Tokai, Eucalyptus saligna, 18 years old	527
Worcester, Eucalyptus globulus (Copse, first 5 years) ...	457
Tokai, Karri (Manor House Ridge)	377
Plumstead, Cluster Pine (14 years old)	341
Worcester, Euc. globulus (first crop over the whole 60 acres)	332
Ceres Road, Euc. globulus, sample area	322
Newlands, Cluster Pine (G. 93, 52 Heywood)	178
Newlands, Cluster Pine (Heywood and Brown)...	170

And he adds:—"An inspection of these figures brings out the curious fact that as much timber can be got in one year from a good Eucalypt plantation, as during 100 years in the indigenous forest—the 'rotation' or life-time of the forest (so to speak) from seed-time to harvest."

If that is so with regard to Eucalypts, it is also so with regard to Pinus insignis, the increment shown at Fort Cunynghame, 526 cubic feet, being as high as anything he quotes except the best Karri (Euc. diversicolor).

Although it will be noticed that the timber is spoken of as of low quality, and the Californian reports speak of it as not used for technical purposes, and practically untried, I have had it sawn up and found that though soft and light it saws clean, takes a good surface, varnishes nicely, and will stand a nail to be driven within a quarter of an inch of the edge without splitting, and it appears to me to be highly suitable for the purposes mentioned above, though not for heavy planking, quartering, or any other such purpose. It seems, therefore, to be not without its place in our forestry, though it must not be expected to do what it was never designed for.

PINUS PINASTER.—*The Cluster Pine* (Figs. 29, 75, 84), is one of the most important items in the forestry of the Cape Colony, and probably it will be found to play an important role here also. A native of the Mediterranean, and largely used in France for sand reclamation work, it was introduced into the Cape many years ago, and finding the winter rainfall and dry summer to suit it, soon became acclimatised, and took to natural dissemination throughout the south-west. Its successful growth led the Forest Department to extend its culture even into the Eastern Province, and now about twelve tons per annum of its seed are used for afforestation work, which is mostly conducted by *in situ* sowing, 20 lbs. of seed per acre being the usual allowance, though in some places much more is given, and in others rather less, in accordance with local circumstances. *In situ* sowing has not been tried in Natal till within the past two years, when that method has been adopted in the Government Plantation at Cedara with highly successful results so far. Of course it is too early till the end of the first rotation (say, 40 to 50 years) to say what the final result will be, but it is an important point gained to know that Cluster Pine can be sown down as easily and as cheaply as a crop of wheat, and be more successful so far as its germination and early growth is concerned. It grows slowly at first, the first season's growth being only 3 to 6 inches, and the next season 12 to 18 inches, but thereafter its growth is more rapid and distinctly vigorous.

The slow early growth, however, necessitates that the ground be clean, and likely to remain so when the seed is sown. It is, therefore, not advisable to use old mealie lands for this purpose, or any other land liable quickly to get full of weeds; indeed, the best practice is to break up fresh veldt, kill the grass thoroughly, and then sow at once. On steep mountain slopes, where ploughing cannot be done, cultivation by Kafir hoe may take its place, depth of loose soil being less of a desideratum than a fresh, clean surface, while on the steep slopes the broken surface left by the Kafir hoe helps to retain whatever rain falls. Although Cluster Pine is not climatically quite at home in Natal, it has thus far done well, many specimens existing in almost every district, from the Coast to the Berg, to show that the tree can stand the climate, and make fairly good growth in it. There is, therefore, every

reason to regard this as one of the future mainstays for the production of sleepers in Natal. Of course for that purpose it requires to be creosoted, but wherever timber is grown for sleepers it should be in quantity sufficient to warrant a creosoting plant as well as a saw mill. If there is reason to doubt the ability of the species to stand anywhere it is in such localities as have a hard dry winter, with a tendency to dry out to the bed-rock.

The timber is not considered of first quality; it is soft and rather coarse-grained, but it takes creosote readily, and thereby becomes one of the most durable sleepers in existence, and with the aid of a bedplate is able to carry the weight of railway traffic, which Pinus insignis is almost too soft for. The tree is largely used in France for the production of turpentine, concerning which process Mueller states:—

"A tree 60 to 70 years old, heavily tapped, yields 12 to 16 lbs. of turpentine, equal to 4 lbs. of resin, the rest being oil of Turpentine (Simmonds). The tree comes into full flow of turpentine at about 25 years, and the tapping process, if only a slight one, is endured by this tree for an enormous length of time. Thus the annual production of resin from a good tree fluctuates between 5 and 8 lbs. The quantity of resin gathered in France during 1874 was about sixty million pounds."

Thus far turpentine collection has not been practised either in the Cape Colony or in Natal, but old trees recently felled in the Botanic Garden, Pietermaritzburg, of the same size and age as that shown in Fig. 29, showed an enormous flow of resin.

Pinus halepensis.—*The Aleppo Pine* (Fig. 34), is rather slower in growth, and more bushy in habit than Pinus pinaster; it consequently requires to be sown or planted closely and crowded during early life if clean timber is desired. It eventually forms a good tree, does well on the coast, and also does well in the midlands and upper districts, standing on a more shallow soil than either of the other Pines. Like Cluster Pine, it can be raised by *in situ* sowing, but as the seed is small about 10 lbs. of seed per acre is enough. Equal to Cluster Pine for most purposes, though more knotty, and not so fast in its earlier stages. Like Cluster Pine, it comes from a winter-rainfall region, but it endures drying-out wonderfully.

When planted a foot apart and kept trimmed into form it makes a beautiful dense hedge, and keeps fit for many years. It occurs frequently throughout Natal and the Transvaal.

Pinus pinea.—*The Stone Pine,* is slower in growth than either of the above, and as it is subject to a fungoid disease which has much interfered with its growth in the Cape Peninsula (where this Pine is abundant), and occurs almost wherever P. pinea is planted, I cannot -recommend anyone to plant this species for commercial work. Even for ornament it has no special qualification, being much like Cluster Pine,

but more flat-headed, old trees in the Cape and Paarl districts being quite umbrella-topped. A few trees of it occur in Natal, nowhere recommending further trial.

PINUS CANARIENSIS.—*The Canary Pine* (Fig. 41), is another more or less maritime Pine from a winter rainfall region in the Canary Islands and North-West Africa, but thus far its growth has been fairly satisfactory from the coast up to Johannesburg. In and around Dundee, however, it is distinctly unhappy, the hot flat country being evidently unsuitable for it. Its growth is about equal to Cluster Pine, but the habit more sparse; in landscape work its glaucous colour gives it a distinct place. While young it coppices freely if its leader gets damaged. Hansen, in the "Pinetum Danicum," says with regard to P. Canariensis in the Canary Islands:—"Under these gigantic trees the soil is dry and poor, and very few plants grow beneath their shade. The Pines grow on the margins of the valleys, and on the steep slopes and rugged precipices which form the sides of the mountains but not on their summits."

PINUS LONGIFOLIA.—*Cheer Pine.* Very like P. canariensis when young, but more robust in habit and foliage. It does well in Natal, though not largely planted, and coming from the Himalayas may be expected to succeed. Timber soft, used for boxes, etc., and the tree yields resin.

PINUS EXCELSA.—*The Blue Pine,* is another species from the Himalayas, but thus far its culture here has been a distinct failure. Many trees of it exist in Natal, they do not readily die, but they do not grow. The same has been the experience in the Cape Colony and Transvaal. This is strange, seeing that it grows naturally along with Cedrus deodara, and dominates it, while here the Cedrus does well and the Pine fails. Possibly on the highest wet peaks of the Drakensberg it may succeed.

PINUS STROBUS.—*The Weymouth Pine,* is very similar to P. excelsa, both in foliage and behaviour. In North-West America it is one of the principal timber pines (known as White Pine), in Europe it has the reputation of being the fastest growing Pine, but here its growth is exceedingly slow.

PINUS SYLVESTRIS.—*The Scotch Pine* (Fig. 29), is also too slow to allow of its being recommended for commercial use. Pinus laricio and Pinus austriaca have both been tried in the Cape, and found slow and unsatisfactory.

PINUS AUSTRALIS.—*Pitch Pine* (Figs. 42, 43), from the southern U.S. America, has done very well here wherever tried. This is rather a surprise, as its natural climatic conditions do not include a dry winter. It seems to do best in deep open soil, and prefers a rising site to a swampy one. There are nice trees in and around Maritzburg, and also near the coast. The timber of this Pitch Pine is largely imported here, and is well known as of the highest value. This Pine deserves extended trial, and will probably be found satisfactory also

on the Zululand coast. In America, where it extends from Virginia to Florida, it prefers dry sandy soils on rolling ground. In the vicinity of the sea, on poor sand, it is very resinous, and known as Pitch Pine; more inland, and on better soil, it is less resinous, and known as Yellow Pine. It is also known as Georgia Pitch Pine, and under several other names, and its timber is said to be more or less proof against white ants. Trees there are seldom more than 20 inches diameter and 70 feet height, but yield much of the Pitch Pine and most of the turpentine, tar, pitch, and resin of that district. It springs up spontaneously in the disused cotton fields.

PINUS RIGIDA is another American Pitch Pine, very different in habit to the last, and thus far not showing any quality to specially recommend it. It is slow, rugged, and hardy, apparently a tree for a colder climate than this. In America it belongs to the N.E. States and Canada, and is better known as a producer of tar and pitch than for its timber production, the timber being little used.

PINUS MASSONIANA (Fig. 70) is a Chinese species which thus far has made fair progress, but is not far enough on to decide what it may eventually be worth. P. sinensis is a variety.

Several other species occur in cultivation in Natal, including P. ponderosa and P. sabiniana, one growing fairly well in Durban, being probably the Californian P. Balfouriana. It will be noticed that though all the above species have been tried final success is not yet assured to any of them, and that there are many other species just as likely to succeed which have never yet had a trial here.

CHAPTER XVII.

TREES PRODUCING CEDAR AND CYPRESS WOODS, AND OTHER CONIFERS.

The term Cedar-wood, like the terms Mahogany and Teak, is applied to several species, some of which are closely related, and others have no botanical relationship among themselves. It is primarily, from a lumberman's point of view, a designation for a certain class or appearance of more or less fragrant timber, though even in this there is considerable variation, and is now used empirically, with several qualifying adjectives for certain species, omitting others which by any system of reasoning would be included also in the same group. The following are a few of the so-called Cedars:—

Cedar of Lebanon	Cedrus Libani.
Indian Cedar Deodar Cedar	Cedrus deodara.
Atlas Cedar	Cedrus atlantica.
Bermuda Cedar	Juniperus Bermudiana
Red Cedar or Pencil Cedar	Juniperus Virginiana
Cedar of Goa	Cupressus lusitanica.
White Cedar	Cupressus thuyoides (Chamaecyparis sphaeroidea)
Mexican White Cedar	Cupressus (Chamaecyparis) thurifera
Oregon Cedar	Cupressus thurifera
Cedar of Japan	Cryptomeria Japonica.
Northern White Cedar	Thuya occidentalis.
Yellow Cedar (N. America)	Cupressus Nootkatensis
*Yellow Cedar (Australia)	Rhus rhodanthema
Clanwilliam Cedar, or Cedar-boom	Widdringtonia juniperoides
Redwood (U. S. America), or Bastard Cedar	Sequoia sempervirens.
*West Indian Cedar	Cedrela odorata.
*Australian Red Cedar	Cedrela australis.
*Moulmein Cedar *Singapore Cedar	Cedrela toona.
Red Oregon Cedar White Cedar of California	Thuya gigantea.
Incense Cedar	Libocedrus decurrens.
White Cedar	Thuya gigantea.
Cedro (Canaries)	Juniperus cedrus.
Cedro (Mexico)	Juniperus Mexicana.

Cedarwood (Guiana)	Icica altissima.
*Bastard Cedar (Jamaica)	Guazuma sp.
*Bastard Cedar (Australia)	Dysoxlyon species.
*Pencil Cedar (Australia)	Dysoxlyon species.

While among so-called Cypresses there are, in addition to all the species of Cupressus, and its synonyms, or slight variations, the following:—

Swamp Cypress	Taxodium distichum.
Montezuma Cypress	Taxodium mucronatum
Yellow Cypress	Thuya gigantea.
Cypress Pine	Callitris (Frenella).
Berg Cypress (Cape and Natal)	Widdringtonia Cupressoides Endl., and W. Natalensis Endl.

Many other trees belonging to these groups go under specific common names, in which Cedar or Cypress is not included. The above are all Conifers, except those marked with an asterisk. It will be seen that with such a variety of Cedars and Cypresses these terms must include several qualities,if not even several classes of timber, and that grouping can only be done in general terms, each species requiring separate consideration by itself, and that being so the various other Conifers are taken here along with these. The best of the Cedar woods are of higher actual value than most of the Pines we have been able so far to grow in Natal, but against that they are often slower of growth, and more inclined to make knotty timber. The latter is ,however, a cultural fault, and can always be prevented by crowding while young, and thinning afterwards as necessary. Some species have, however, made rapid growth, and there are many of this group which have not even been tried as yet in Natal, and which there is reason to expect will do well.

Fig 21 shows the habit assumed by Cupressus sinensis (a) unpruned and allowed to develop as an ornamental tree, (b) badly pruned after having developed heavy branches, as so often happens, and (c) grown as a timber tree by sufficient crowding while young, to suppress all heavy branches, and send the growth into the main leader instead. There are no more ornamental trees in existence than the members of this group when well developed, but as such their timber is spoiled for technical purposes; there is no more useful class of timber when grown for timber, as distinct from ornament. The two purposes cannot, however, be combined in these trees, and any attempt to do so usually results in failure for both.

In advising the Transvaal Government regarding its forestry, Mr. D. E. Hutchins, Conservator of Forests, Cape Town, says, concerning the Eastern Transvaal, which closely resembles Natal in climatic conditions:

"It is certain that the eastern side of the Transvaal is now climatically fitted to carry forest of high economic value. It closely resembles Mexico, and Mexico is peculiarly rich in its Pines and Cedars, trees which produce the exact class of tim-

ber now imported at such heavy cost from the Northern Hemisphere to the Transvaal. It is nearly certain, further, that, if the Transvaal, with its present climate, had been situated in the Northern Hemisphere, Cedars and Pines, now entirely absent from its forests would have abounded.

"*Cedars.*—It is the Junipers that yield the typical Cedar wood. There are about thirty species of Junipers, but only about two-thirds of these are large enough to be of economic value. Of other trees yielding Cedar there are 15 species of Cypress, 5 of Libocedrus, 2 Sequoias (one the finest timber tree of all the Cedars, and one second rate), 2 Taxodiums (both first rate Cedars), 1 Glyptostrobus. 1 Skiadopitys, and 2 Cedrus. There are about thirteen species of Callitris (including Actinostrobus, Widdringtonia and Tetraclinis), *i.e.*, 9 Australian, 2 Cape, 1 Central African, and 1 North African. It is the genus that after Juniperus and Taxodium produces the best Cedar-woods. The Callitrises are somewhat faster-growing than the Junipers, but slower than the Cypresses. Cape Cedar, the most valuable indigenous timber of South Africa, is Callitris arborea. C. Whytii is the Mlanji Cedar of the temperate highlands of Central Africa. The Australian Callitris calcarita has the texture of Cedar, with the colour of Stinkwood, and is the handsomest timber in the Kew Museum."

CEDRUS is the generic name of the original Cedar so often mentioned in Biblical writings, both as a useful timber and as a burnt offering. There are only three species closely allied and connected by intermediate forms. These are:—

CEDRUS DEODARA.—*The Indian Cedar*, or *Deodar* (Figs. 35, 40). A tree of most graceful habit, and glaucous colour, the branches spreading horizontally and drooping towards the points. It is a native of Afghanistan and the Himalayas, extending along nearly the whole range from 5,000 to 12,000 feet altitude, except the wettest Eastern Himalayas, and growing into enormous trees, of which several are recorded as 30ft. in girth and 150 to 200ft. in height, but Gamble estimates that it is at its best in "good localities at about 12ft. in girth, and that an average tree gives 50 sleepers 6ft. x 8in. x 4½in." Nansen states:—"But to see the Deodar in its greatest perfection, one must visit the snowy ranges and lofty mountains of the interior, far from the influence of the plains, and where for nearly half the year it is enveloped in snow; there its dimensions become gigantic. . . . . As a general rule the finest trees always are found growing on the north side of barren mountains, in thin, poor soil, formed from the decomposition of granite, gneiss, mica, or clay-slate."

In Natal no such snow conditions can be presented, but as the Deodar has already shown its aptitude to thrive under local conditions in the midlands and uplands, it is evidently elastic to a certain degree in its nature. It does not, however, thrive toward the coast, and should not be used below 2,000ft. altitude.

Around Maritzburg there are many fine trees 20 or more years old, doing best in the deep soil and moist conditions north of the City, though there are also good trees on the shallow shale soils toward Fox Hill, one of which, a grand old specimen at Mr. Blackborough's was excessively damaged by hail during January, 1903, after having flourished without injury for over 30 years. The same storm also killed or badly damaged many other trees in the same garden, including two nearly mature trees of Pinus longfolia.

On the Noodsberg and Karkloof there are pretty specimens, as also at Ladysmith, Dundee, Johannesburg, and Pretoria, and in many parts of Cape Colony, though there it has done best at stations like Eveleyn Valley, where occasional snows fall. In England it is everywhere successful while young, and concerning its growth there it has been well said:—"Its graceful and beautiful form in its young state, and its grand and imposing aspect in its maturity, place it in the highest rank as an ornamental tree, its value as such being greatly enhanced by the readiness with which it accommodates itself to almost all situations. No position and no variety of soil appears to come amiss to it; on lime or sandstone, rock or clay, it grows with equal facility."

Concerning the quality of its timber as grown in India Laslett states:—"The heartwood is light, yellowish brown, moderately hard, and distinctly fragrant, and the resin is not in distinct canals though abundant. The annual rings are very even, and the quality of well-grown timber is excellent; in fact, it is the most durable and useful of the Himalayan Conifers, and must be regarded as by far the most important timber of North West India, where it is employed for all kinds of construction—sleepers, bridges, carpentry, furniture, and shingles." Gordon says:—"The boatbuilders . . . . . consider it the most valuable of all for its durability, both for naval and architectural purposes, the wood being compact, rather close-grained, long-fibred, highly resinous, deliciously perfumed, and lasting for a great number of years, even though much exposed to the elements, being but little affected by water, as boats built of its timber will last for 20 or 30 years, while those built of the 'Cheer' (Pinus longifolia) only last six or seven."

It must be noted, however, that in India its timber is not all of equal value, for in reference to some mountain-grown specimens Nansen states:—"Here, too, the character of the timber was different from that grown in southern aspects and rich soil, being more compact, harder, and of a deeper red, owing to its slow growth." This is almost to be expected, for Brandis explains that whereas 200 years are required to give a girth of six feet in some of the drier Indian climates, 70 years is sufficient to attain this where the rainfall is greater. Natal trees are doing better even than this around Maritzburg, but the timber must be expected to be correspondingly softer, and pro-

bably up-country timber will correspond closely with the Indian product, but take longer to mature."

Gamble mentions a log having been unearthed 90 feet long and over 7 feet diameter at the base, which had been dead for at least 100 years, and which when cut up gave 460 metre-gauge sleepers, besides other material. He estimates its age when it fell at 550 years, but it is probable that it was mature centuries before that. The weight of the dry timber is about 35 lbs. per cubic foot, and Gamble states regarding it:—"Deodar wood is very durable, probably, with Cypress, the most durable of Himalayan woods. Stewart mentions the pillars of the Shah Hamaden mosque at Strinagar in Kashmir, which date from 1426 A.D.., and are now consequently (1901) 475 years old, as having been quite sound at the time he wrote. It resists wet, also white ants, and apparently does not suffer much from dry rot."

The oil in the timber prevents it from being water-logged while being floated down from the Himalayas, as it always is, and probably has much to do with its durability.

Mueller states:—"White ants hardly ever attack the heartwood. Boats built of this wood have lasted about 40 years. It is also extensively used for canal-edges and for railways. Mr. J. S. Gamble's experience shows that in India Deodar railway sleepers withstood decay considerably longer than those of Sal, and much longer than those of Teak. The trees should not be felled too young. It yields a good deal of resin and turpentine. A humid clime very much accelerates the growth of this pine, which would come best and quickest to its development in forest ranges."

On the Himalayas it grows intermixed with Pinus longifolia in its lower limits, with Pinus excelsa in its middle zone, and with Spruces in its upper range, the two latter requiring conditions impossible here, but indicating that the Deodar should be most successful in the upper ranges of the Yellowwood belt, but may also be successfully employed in the Drakensberg gorges, especially those facing south-east, where, indeed, it promises as well as any as a sleeper timber, enduring cold and storm better than any other. When grown for ornament it stands well, and shows best as single specimens, but it is also found to endure a great deal of crowding without injury or much loss of growth, and grown in that way forms better and cleaner timber. The Polela, Underberg, Giant's Castle, Oliver's Hoek, Cundycleugh, Normandien, and Karkloof slopes are where it may be planted commercially, but as seed is difficult to procure in good condition, and plants are usually scarce, it may be planted, say, twenty feet apart, and the intervening space filled with Cluster Pine, sown *in situ*, and intended to be thinned gradually, and eventually all removed as soon as the Deodar requires all the space. An interesting set of experiments detailed in the Indian Forester, December, 1904, shows that at Bodyar, in the N. W. Himalayas, at an elevation of

about 8,000 feet, Deodar sowings and plantations failed on hot sunny aspects upon bare grassy slopes unless provided with shelter by some other tree or shrub, but that Pinus excelsa sown at the same time suppressed the Deodar unless controlled. A certain amount of crowding appears to be necessary; too much is harmful.

At Ravensworth, where several trees are growing, one standing near the cattle kraal indicates by its vigour that it benefits by such proximity. There the soil is deep and red, without lime, and too poor to grow mealies. At tne Botanic Garden, Pietermaritzburg, the soil is deep rich alluvial (Fig. 40), at Morningside (Fig. 35), and at Mr. Topham's, where the Deodar does well, as also at Mr. Blackborough's, already mentioned, the soil is shallow, overlying shale, while at Ladysmith the soil is deep, but rather stiff, approaching clay in texture. In India, however, Gamble states that it does not succeed either at Darjeeling, or on the Nilgiris, where there is too much clay, and it is probable that the ultimate dying out of many trees in England is due to insufficient selection of soil. Concerning its growth in the Transvaal Mr. D. E. Hutchins states:—"Grows splendidly all over the Transvaal. One of the first timber trees of the world. Timber,a Cedar. This tree will do best in the wetter districts, but I have never seen it fail in any part of the Transvaal, and it may safely be planted in millions. It may, in Transvaal forestry, occupy the position of the Oak in European forestry. There are numerous well-grown specimens of this tree in Natal"; and again he states: "The Deodar is already growing well in the Transvaal, and so far as one can see it is likely to become the chief timber tree in the Transvaal forestry of the future."

The dry winters, instead of the snow-clad winters of its native home, form the only element of doubt as to its success to maturity, and this should be remembered when selecting sites for commercial planting. Even in Britain, where it does well while young, comparatively few trees live to maturity, and the climate there is more according to its nature than is ours.

In England several varieties have originated in sports, and been perpetuated by cuttings; these are not yet obtainable here, but their qualities are indicated in their names, viz., aurea, argentea, crassifolia, robusta, virdis, and verticillata-glauca. In the Indian forests dark green and silvery varieties occur.

When mature the Deodar forms a flat-topped umbrella, with a clean stem, but so far as known here it is still in the condition of being feathered to the ground with graceful pendulous branches.

In nursery treatment the Deodar should be transplanted only when more or less dormant, as the young growth is apt to suffer if already on.

CEDRUS LIBANI.—*The Cedar of Lebanon,* is similar in general characters to the Deodar, but more rigid and less drooping in habit, with the stem usually much forked, and the branches

horizontal. Formerly in high repute as a durable scented timber, used in the construction of Solomon's Temple, the Temple of Diana, and other renowned buildings, as well as in more homely domestic architecture, the demand upon it has been such as to practically exhaust the supply, and make the indigenous forests few and scattered. Its timber is consequently not now on the market. In cultivation it grows more slowly, and with less vigour and elegance than the Deodar, and specimens grown in England have not maintained the reputation of the timber as being hard and durable, though where it grows wild it still bears that character. One of the oldest specimens in England is at Bretby Park, Derbyshire; its size is given in the Report of the Conifer Conference, 1892, when 215 years old as: Height, 82ft.; girth at 5ft., up to 16ft. 2in.; spread of branches, 85ft. The soil where this tree grows is a deep black loam of good quality, resting on sandy clay. Bellon, writing on these Cedars in their native habitat (1553) says: "They grew in moist places, like those in which the Spruce Fir (Picea abies L.) delights, and they are also found in moist valleys." Other writers speak of it as growing where it is often under snow. There are few specimens in Natal, and there seems no great inducement to plant it, the Deodar being more ornamental, though different in habit, of better timber, and forming a better bole. As a mountain tree, for the most exposed situations, it may have its use for shelter and ornament, but its slow growth and branching habit render its commercial growth for timber impracticable.

CEDRUS ATLANTICA.—*Atlas Cedar* (Fig. 35), a North African species somewhat similar to the Deodar, but less drooping. It makes growth about equal to the Deodar in Maritzburg, and like it, usually maintains a single main stem. It stands fairly well on shallow shale soil, but, of course, does better with more depth. Veitch states (Manual of Coniferae):—"As a tree for the park and landscape in Great Britain, Cedrus atlantica is unquestionably the best of the three Cedars taken in all its bearings, among which special stress should be laid upon its hardiness, its adaptability to many soils and situations, its rapid growth, its pyramidial but not too formal outline, and, lastly, its glaucous foliage, which, when heightened to a silvery whiteness, affords a picture unsurpassed by any other coniferous tree in cultivation, whether standing alone or in contrast with the greenery of other trees."

Its timber is in demand in Algeria, and used for many purposes.

JUNIPERUS yields first rate cedar wood in such species as grow to timber size. There are many species, widely distributed over the Northern Hemisphere from the Arctic regions and the upper limits, of arboreal vegetation on mountains, to Mexico and the West Indies. Many of these are mere shrubs,

others fine trees. Only two species are common in cultivation in Natal. These are:—

JUNIPERUS VIRGINIANA.—*Red Cedar* or *Pencil Cedar* (Figs. 30, 70). This has been found one of the safest trees to plant throughout South Africa, on account of its doing well on any class of soil (except brack), and at any altitude. It is never a rapid grower, and never makes a large tree, but it never fails. Even where soil is almost absent, and rock immediately underlies it, it holds better than any other tree. Consequently it is found in Dundee, Ladysmith, and similar localities, where tree culture is more or less difficult, and, at the same time, does very much better in the midlands and on the coast. It can be used in the Thorn-veldt as a hedge or even as a tree. It comes from North America, where in its different varieties, or in hardly distinct species, it inhabits half the continent, enduring every variation of climate and soil; sometimes as a dwarf bush, sometimes as a fine tree, 60 to 80 feet in height and 12 to 18 inches dimeter. Veitch states (Manual of Coniferae): "In the Atlantic States it is usually scattered over dry slopes and rocky ridges; on the coast, often stunted and with short tough branches that resist the fiercest gales; further inland, as in Kentucky, Tennessee, and adjacent States, it is a medium-sized tree, covering large areas with nearly pure forests; in the humid and hot climate of the Eastern Gulf States it attains its greatest dimensions, becoming a tall wide-topped tree of very elegant aspect; towards its western limits, and on the Rocky Mountains it is often reduced to a low bushy shrub."

The southern form, which attains the largest size, and is sometimes separated under the name J. barbadensis, forms the source of supply of the cedar-wood of the Southern States, an article of considerable commercial importance. This tree is probably too slow growing to compete with Pines and other Conifers in the middle districts of Natal, but in Lower Zululand it will probably be found most valuable, judging from how it does along the Natal Coast, and it is from this variety that seed should be procured. In Johannesburg and the Transvaal it also does well. It has a strong tendency to become thoroughly naturalised, self-sown seedlings coming up freely, and growing on, especially on shallow soils overlying shale, as at Topham's and Blackborough's, near Maritzburg, though the same tendency is also seen on the Maritzburg Town Hill, where the soil is deep. As birds eat the fruits, and disseminate the seeds, it may eventually establish itself.

Concerning its timber qualitites, which have not been tried here as yet, Veitch states:—"The wood of the Red Cedar is one of the most valuable of the forest products of North America. Its use in the manufacture of 'Cedar pencils' is well known; its resistance to decay by water is so great that no better wood can be found for fencing posts and railway ties, door sills, and other purposes in which woodwork is in contact with the soil. Moths flee from its pungent odour, and a chest or closet lined

with this wood affords an efficient protection against their inroads. From the waste of pencil factories a kind of paper is manufactured that has been found useful in underlaying carpets and for wrapping wools, furs, and other articles liable to be injured by moths."

Mueller states:—"A handsome tree, rarely 90 feet high, supplying a fragrant timber; it is dense, fine-grained, light, and of pleasant odour, the inner part is of a beautiful red colour; the outer is white; it is much used for pencils; one of the best of all woods for buckets, tubs, and casks. Simmonds observes that fence-posts of this wood last for ages. Of wonderful durability for railway cross-ties. The heartwood is almost imperishable, nor is it bored by insects. One cwt. of wood yields in distillation at an average 28 ounces of fragrant oil, used for scented soaps."

The nursery treatment of the Junipers is rather difficult, the seeds seldom germinating during the first year. They should be mixed with sand and kept wet in the nursery for a year, then sown for germination; or else the seeds should be separated out from the berries before they are sown while quite fresh.

In European nurseries J. virginiana is used as a stock on which to graft some of the rarer Junipers, but it is itself a most ornamental tree, especially towards autumn, when its foliage assumes a deep red colour, which becomes most intense under the hardest conditions of growth, and is said to be more pronounced in the male than in the female plants. It forms a very nice compact hedge, and can be kept within hedge size for many years by frequent clipping. There are many varieties, some erect, some drooping, but as all the trees here are seedlings none of these have as yet been perpetuated by cuttings as they have in Europe.

JUNIPERUS BERMUDIANA.—*Pencil Cedar*, of Bermuda (Fig. 41). This is a more tender tree than J. virginiana, therefore even better adapted to the Coast districts of Natal and Zululand, where it grows to perfection on most classes of soil and situation. It is less satisfactory above the Yellow-wood belt, but does well again in the Transvaal. It is naturally inclined to form too many heavy branches at the base, consequently requires crowding or pruning if for timber purposes, though for ornamental work these heavy branches are useful. A native of Bermuda, where, according to Veitch "It grows well-nigh everywhere on the Islands, in the most diverse situations, from the low brackish swamps along the seashore to the dry limestone hills inland." It has, however, been so reduced in quantity that it is no longer a commercial timber to the extent it used to be, its use now being practically confined to the manufacture of lead pencils, for which, together with J. virginana, it commands a high price.

It yields a first-class fragrant timber, and grows in Natal up to 2 feet diameter, though tapering rather rapidly. On the

coast its growth is faster, and ultimately larger than J. virginiana, but usually more straggling and less ornamental. Mueller states:—"This species grows sometimes to 90 feet high, and furnishes a valuable red durable wood, used for boat-building, furniture, and particularly pencils, also for hammer-shanks for pianofortes, on account of its pleasant odour and special fitness. The tree will thrive in the poorest soil, for instance, coral sand, and has a very great power to resist storms on account of the deeply penetrating roots, which may reach to 30 feet." Nursery culture same as that of I. virginana, both germinating irregularly during several years.

Other Junipers grown in Natal include J. excelsa and J. oblongata, in the Botanic Garden, Durban, and J. prostrata, a procumbent shrub, and J. communis, as a hedge shrub, in Maritzburg and elsewhere. None of the other tree kinds are known to occur, but several are well worth trial for ornament if not for timber, including:—

J. oxycedrus, a small tree from North Africa, and its larger varieties or sub-species, J. cedrus and J. brevifolia, from the Canary and Azores Islands.

J. Chinensis, a tall tree from China and Japan, which, with yellow and glaucous varieties, is cultivated in Europe for ornament.

J. excelsa (including J. macropoda and J. procera), an alpine tree from eastern Himalayas and eastern Asia, where it forms large forests of large trees just below the Cedar belt, and where its timber is considered of value for domestic purposes, though too inaccessible for higher technical use.

J. flaccida, a small tree from Mexico, more ornamental than useful.

J. occidentalis, a forest tree in the mountains of California and Mexico.

J. pachyphloea, another large Mexican tree, extending northward through the dry desert ranges of the neighbouring States. Should be tried in the Natal uplands.

J. recurva, an Indian tree, having several forms, and concerning which Gamble states: "The wood is very good, quite equal to the best Pencil-cedar."

J. communis, and J. sabina, both shrubs fit for hedges, or, in their more dwarf forms, for garden edges. One dwarf variety in cultivation here is progagated easily by breaking up and replanting.

CUPRESSUS (including *Chamaecyparis*) is a large genus of most ornamental trees, found more or less throughout the Northern Hemisphere, and largely cultivated for ornament wherever horticulture exists. Every species is fit for ornamental planting where it succeeds, but the economic value of the timber of some species is also of the highest importance. All the species seed readily, and are easily reproduced from seed, though liable to much variation, probably through hybridisation. The more characteristic forms are consequently raised

from cuttings in Europe, and thereby kept true to their characters; here seedlings alone occur, and there is often disappointment felt when a tree sold as C. pyramidalis turns out to be C. horizontalis, a most natural vagary considering that both occur from seed of one tree if cross-fertilized. This tendency to hybridisation throughout the genus, together with the obscure characters by which the species are separated, render it doubtful what species are actually growing in Natal, only the most characteristic forms being known with certainty, while the fact that some species hardy here are too tender for cultivation in Northern Europe, or different in appearance under the varying conditions, also renders identification difficult.

CUPRESSUS SEMPERVIRENS.—The *Common Cypress* (Figs. 29, 31, 69, 78) is the Cypress of ancient history and Holy Writ. It occurs throughout Southern Europe, Western Asia, and eastward to the Himalayas, frequent in cultivation there as elsewhere, but not obtainable in quantity in the wild state. It is found to grow well throughout Natal, and, indeed, throughout South Africa, fine old specimens occurring at isolated Dutch farmhouses, as well as in all the older towns and villages, where its use is more general than any other tree except the Poplar and the Willow. It likes deep alluvial soil, not too wet, but is not averse to poorer conditions, though it grows more slowly under these. It hardly ever dies of drought; occasionally it dies from saturation if a water-tap is placed near it. Of rapid growth under favourable conditions, it soon grows into timber size, but has nowhere been planted as a timber plantation. It occurs in two very distinct forms, viz.:—

C. horizontalis, The *Spreading Cypress* (Figs. 19, 69, 78).

C. pyramidalis (C. fastigiąta), The *Upright Cypress* (Figs. 31, 78).

These differ widely in appearance in their extreme forms, but every gradation occurs between them, and both can be grown from seed of one tree, so if either variety is desired pure the seed should be selected from trees growing at a distance from trees of the other variety, to prevent hybridisation. C. horizontalis is an ornamental tree, with a pyramidal habit, and spreading branches; it grows eventually into a timber tree 100 feet high and 2 feet diameter. C. pyramidalis is compactly columnar in habit, equal in height, but usually without a good bole, and consequently of little use as a timber tree. In South Europe C. pyramidalis is often cut into grotesque forms: it also can be used with advantage in hedges, and as a cemetery tree it is the universal favourite. The timber of C. horizontalis earned a reputation for being indestructible centuries ago; this probably applies only to old and well-matured material. Veitch states (Manual of Coniferae):—" The economic value of Cupressus sempervirens is restricted to the amount of timber available for use, which does not appear to be very considerable. The wood is virtually indestructible by ordinary agents except fire; this remarkable durability was known to the Greeks

and Romans, who employed Cypress-wood in the construction of various articles of furniture, also for vine props, posts, and palisades, and especially for coffins, which were found to resist decay for ages after being buried in the earth."

Mueller states:—"The wood is prized for trunks and boxes, as rendering the contents proof against most kinds of insects. At present its wood is much sought for the manufacture of musical instruments. Young records the stem-circumference of a Cypress at Lake Maggiore at 54 feet, and this was known even 600 years ago as a venerable tree."

In Brown's Forester it is recorded:—"Its fragrant wood is of excellent quality, and very great durability. Perhaps there is no forest tree that produces better timber than the common Cypress. In very old buildings in Italy it is known to have stood from 600 to 1,000 years, and is still sound. In this country no practical experience has been available as to its durability; but it is of common use in Candia and Malta, where it is considered the most durable of all timber."

Hutchins says:—"Perhaps only second to the Deodar in the future forestry of the Transvaal."

CUPRESSUS LUSITANICA.—*Cedar of Goa*, or *Portugese Cypress* (Figs. 29, 32, 38, 43). A splendid tree from Indian and Eastern Asia, and one of the most successful introductions into Natal. It grows well throughout South Africa, naturally assuming a widely branched pyramidial form, but by crushing can be transformed into a tall clean-stemmed tree, yielding valuable timber. In Natal it is equally successful on the Coast, where it can be used as a wind break, as well as an ornamental tree; in the Midlands, where it shows its greatest timber development; and in the upland flats, where it is more successful than most other trees. It also can be used in the Thorn-veldt, and in places where it succeeds well self-sown seedlings spring up readily. In and around Maritzburg trees occur 60 feet height and 2 feet diameter, and still comparatively young. It varies immensely in colour and habit, forms passing under the names C. sinensis (Fig 21), C. glauca, and C. pendula glauca (Fig. 32), and forms recede toward other species. Where allowed full spread for its branches these extend far outward, those in some of the streets of Cradock (Cape Colony) arching and nearly meeting over a wide street. It has the general habit of C. macrocarpa, but different colour, smaller cones, and more hardy nature. The timber is much like that of C. torulosa, but has hardly been tried as to its technical qualities.

CUPRESSUS TORULOSA.—*Himalayan Cypress.* This tree makes as good growth as any Cupressus in the Natal Midlands, growing into a fine erect tree, less branched than C. lusitanica. Trees at Mr. Henderson's farm, "Hilton," have beautiful boles, which by crowding are almost clear of branches, and look like timber forest. It comes from the Western Himalayas, from districts as dry in places as the Natal yellowwood belt, but can stand more rain.

Veitch states:—"The wood is white, tinged with red or yellow, deeper in the centre, even-grained, easy to work, but not strong; it is occasionally used for joinery and indoor fittings."

Gamble states:—"The timber is very durable, even more so than deodar, as is shown by the results of buried sleepers of the wood at Dehra Dun (Ind. For. xix., 207). These pieces were put down in 1881, and taken up in 1892, eleven years later, and the Cypress wood was found to have resisted the best of all. It has been found very good for sleepers, but is not procurable in sufficient abundance to be much used. The average weight is about 38 lbs. per cubic foot. It is good for building, equally with Deodar, and is frequently employed for temples in the Himalayas, as well as for images and poles to carry the sacred arks. The wood is also burnt as incense."

Mueller says:—"The reddish fragrant wood is as durable as that of the Deodar-cedar, and highly valued for furniture. The tree prefers limestone soil. Splendid for windbreaks and tall hedges." And Hutchins says:—"A first rate timber, more durable in the ground than Deodar."

CUPRESSUS MACROCARPA.—*Monterey Cypress*, or *Scented Cypréss* (Figs 40, 51, 82, 83). A large tree of rapid growth and spreading habit, usually heavily branched from the base, and consequently having little timber-bole, except these branches are pruned off. As an ornamental tree it has few rivals, its fine spreading habit and central leader, its dark green colour, and scented foliage giving it qualifications possessed by few As a timber tree, however, its qualities are fewer, as its knotty timber, heavy branches, heavy taper, and liability to die off suddenly are all against it. On account of its rapid growth and ornamental appearance it has been largely planted throughout South Africa, but being in a climate the reverse of its own it has shown a tendency to die out before it is 20 years old, especially where the soil is shallow and the winter water supply consequently inadequate. An erect close-habited form of it is propagated by cuttings in Europe under the name of C. lambertiana.

In its native home in California its occurrence is restricted to a narrow belt about two miles long and scarcely more than 200 yards wide, extending along the coast; where the exposure to sea winds has produced a horizontal habit of branching similar to that of old Cedars of Lebanon. While it is climatically not reliable here as a timber tree, and in any case does not excel the other species of Cypressus, its use as an ornamental tree is assured, and even as a strong hedge it has few equals. In habit it resembles C. lusitanica, but its colour is dark green, and it branches more.

CUPRESSUS LAWSONIANA.—The *Lawson Cypress*, has been cultivated for many years in Europe, under many varieties of colour and form, and is a great favourite there for landscape effect. Here it has been less successful, for though it does

not readily die it grows so slowly as to leave no hope of its ever being a timber tree, while on the coast it does not succeed even as a garden shrub. In its way it is ornamental, and almost fernlike in its growth, but evidently it requires a colder and moister atmosphere than it can get here except in the mountain gorges, or in the moist parts of the mist-belts, as at Zwartkop, Boshoff's Road, and Hilton Road, where there are nice ornamental trees of it. In its Californian home it is a rigid clean-stemmed timber tree, the timber, as described by Sargent, being light, hard, strong, and very close-grained, abounding in resin, very durable in contact with the soil, easily worked, and susceptible of receiving a beautiful polish. It is much used in indoor joinery, flooring, fence-posts, ships, and boat building, etc.

CUPRESSUS FUNEBRIS.—*Weeping Cypress.* This Chinese species is a favourite throughout South Africa for cemetery use, its slow growth and weeping habit making its presence there appropriate. It is the slowest of those in cultivation here, but occasionally produces fairly good boles 30 to 40 feet high, and 9 inches diameter. It is not fit for use as a timber tree, but does well for ornament.

Cupressus thurifera, *Mexican White Cedar*, C. fragrans, *Oregon Cedar*, Cupressus Benthami, C. Knightiana, C. Goveniana, C. Guadalupensis, C. Lindleyi, and C. MacNabiana, are Mexican, or West American, species, not yet known here; probably worth introduction.

CUPRESSUS THUOIDES.—*White Cedar.* Not yet tried here. but probably suitable for the Zululand coast. Veitch states it "inhabits the cold swamps of the Atlantic and Gulf coast plains (Maine to Florida), usually immersed during several months of the year, frequently covering them at the north with pure dense forests, or at the south mingling with the deciduous Cypress Taxodium distichum." As Taxodium distichum does well in Natal it is probable that this will also. Concerning its wood he states it "is light, soft, not strong, close-grained, easily worked, slightly fragrant, and very durable in contact with the soil, it seasons rapidly and perfectly without warping, and is largely used for boat-building, cooperage, telegraph and fence-posts, railway-ties, and wherever durable wood is desired. The importance of the White Cedar in the Atlantic States is increased by the fact that, attaining its greatest proportions in situations where no other useful timber tree can flourish, it gives value to land which without it would be worthless."

TAXODIUM DISTICHUM.—*Swamp Cypress*, known also as *Black Cypress*, *White Cypress*, and *Bald Cypress* (Fig. 40). This tree, by the success it has attained in and around Maritzburg and elsewhere in Natal, has secured a place in our confidence which climatic and geographical conditions alone would hardly have given it. It belongs to the swamps of the South-Eastern United States, where it attains large size, and

is of considerable commercial importance. It is deciduous, its leaves turning red before they fall, while its spring growth is glaucous, turning afterwards to green. It has, consequently an everchanging landscape effect. Here it makes rapid growth on fairly deep open soil, rocky situations, or stagnant moisture do not seem to suit it. This is all the more strange, since in its native home it is usually inundated more or less throughout the winter; indeed, Sargent states that the depth of water in the southern swamps prevents natural reproduction of this Cypress, the seed cannot germinate, and there are no young trees, and comparatively few small ones to replace the old ones. From its native habitat it ought to succeed in the Zululand swamps. The timber is now being largely worked, the inundated sites occupied having saved it for a time. Veitch states that it is "light, soft, straight-grained, easily worked, and very durable in contact with the soil. It is largely manufactured into lumber, and used for construction, railway-ties, posts, fencing, shingles, etc."

TAXODIUM MUCRONATUM.—*Montezuma Cypress*, is hardly distinct from the last, but coming from a climate more like ours will probably be found the best form to use.

A beautiful tree at Mr. Henderson's farm, "Hilton," resembling a Taxodium in general appearance is probably Dacrydium cupressinum, the *Red Pine* of New Zealand. Concerning this tree Kirk states it "occupies a larger area of the New Zealand forests than any other timber-tree, and affords remunerative employment to a larger number of workers. Although of less intrinsic value than Kauri or Totara, it is adapted to a larger number of important uses, and is easily converted; these advantages, together with its wide distribution and grand abundance, render it the most important commercial timber of the Colony."

SEQUOIA SEMPERVIRENS, END.—(Taxodium sempervirens Lam.), *Redwood*, or *Bastard Cedar*. One of the largest trees in existence, growing naturally in the moist mountain gorges near the Atlantic coast in North California, a region of summer mist and winter rainfall. The latter condition is not easily met in Natal, still there are several specimens of the Redwood doing very well, one in Wilkinson's Nursery being about 20 years old, and a beautiful healthy tree. It is, however, in a moist shady spot, on deep soil, and growing along with Rhododendrons, Hollies, and other northern trees unusual here. In selected spots throughout the mist-belt, especially from Eshowe to Nkandhla, and on the Karkloof, it will probably succeed; elsewhere its cultivation does not promise well. Hutchins calls this one of the finest timber trees in the world, and Veitch states:—"The Redwood is the most valuable of all the Californian timber trees; it is the most common building material of the State, and is used for every description of out-of-door carpentry. The wood is close-grained, and splits with peculiar facility by means of wedges,

so that planks can be made from it without the use of the saw; it is durable in contact with the soil,, and it is therefore extensively used for fencing and railway-ties; it is of a beautiful red colour, and susceptible of a high polish, qualities which render it peculiarly adapted for all kinds of domestic furniture, and so highly valued is Redwood timber beyond the range of its native forests that it is exported to Australia,the Pacific Islands, to China, and even occasionally to Europe."

SEQUOIA WELLINGTONIA, SEEM.—(Wellingtonia gigantea, Lindl.) Another of the largest trees in the world. The climatic conditions of Natal do not meet its requirements, and though often tried no good specimen now stands. This is of less consequence since the timber, though durable, is inferior to that of other kinds fit to grow here.

CALLITRIS (including Frenela) is a genus of trees mostly Australian, producing Cedar-like timber, which has thus far received comparatively little attention in cultivation. Several species occur in Natal, but beyond C. rhomboidea, which is often used as a hedge plant under the name Oyster Bay Pine, the species are not identified, consequently the comparative growth of species cannot be given. One species at Mr. Henderson's Town Hill estate, Maritzburg, is making good clean boles a foot in diameter at about 20 years of age, and is doing as well as Cupressus lusitanica on the same ground, but most of them are considerably slower than the Cupressus species, and consequently less worth growing.

CALLITRIS CALCARATA is said to form a large tree, yielding valuable Cedar-wood. Mueller states:—"A tree to 70 feet in height and 3 feet stem-diameter. Spreads rapidly over sterile, particularly sandy land. Wood of local importance, strong, durable, and of agreeable smell. It is used for piles, and furnishes planks for boats; it is repugnant to termites."

Callitris robusta is the *Cypress Pine*, or *Black Pine*, of New South Wales, also considered valuable locally.

There are several other Australian species of local use, and C. quadrivalis is from North Africa.

C. RHOMBOIDEA, used as a hedge plant, requires frequent clipping, if allowed to grow too far, and then cut hard back it is apt to die out in single plants, leaving gaps which are difficult to fill. As a tree it is poor and lanky.

WIDDRINGTONIA is closely allied to Callitris, and sometimes included in it. One species, W. cupressoides, Endl. (W. Natalensis, Endl.), is a native of the Natal Drakensberg, and certain mountains in Cape Colony. Usually it is a small shrub 8 to 10 feet in height, but in cultivation in Natal some trees of it go to 30 feet height and 2 feet diameter. It is an ornamental shrub, and has been used in the Cape for reclaiming coast drift sand. Widdringtonia juniperoides, the *Clanwilliam Cedar*, is one of the most valuable timbers of the Cape, but its

habitat in the winter-rainfall localities, and its absence elsewhere, renders it unlikely that it will succeed in Natal except in the Drakensberg, where the snows might affect it.

WIDDRINGTONIA WHYTEI.—The *Mlanji Cedar* (Fig. 42), coming from gorges in the Shire highlands, is more likely to do well here, and so far as it has been tried in Maritzburg, and even near Durban, it has done well, but it is as yet only about ten years old. It forms a large tree, and its timber is considered valuable.

LIBOCEDRUS is a small genus of fine trees from scattered localities, but all yielding valuable, scented, durable, and useful Cedar-woods They are almost, or altogether, unrepresented here except by recently introduced plants, but it is probable that several would succeed in the mist-belt, and be valuable alike for ornament and for timber.

Libocedrus decurrens, the *White Cedar*, or *Incense Cedar*, of California and southward to Mexico, is a large tree which has done well in England, and would likely do well here. Veitch says:—"Its timber is highly valued; the wood is light, durable, and close-grained, but not very strong; it is used for a great variety of purposes, including house furniture and indoor carpentry."

L. Doniana, from New Zealand, L. tetragona, and L. Chilensis, from Chili, and L. macrolepis, from China, are all suggested for trial.

CRYPTOMERIA JAPONICA.—The *Japanese Cedar* (Fig. 75). The timber tree of Japan, yielding a durable, soft, fragrant timber, so much in demand that the tree has almost disappeared from its native habitats, though formerly plentiful; the Japs have, however, been planting it for centuries, and fine trees a hundred years old are now plentifully in evidence there. It has sported into several varietes, propagated in Japan and in Europe by cuttings, one of which, C. elegans (shown in Fig. 75) is growing at Lynedoch, Nottingham Road, though usually seedling plants only are available here. The Japanese Cedar does well throughout the Midlands of Natal and on the uplands wherever there is sufficient rainfall, as along the Berg, but on the coast it is a failure. A plantation of it at Wilkinson's Nursery grown forestal fashion is doing well, but evidently it grows much faster when given more space. As a timber tree this should only be used where there is a heavy rainfall and a deep open soil, but for ornament it stands considerable abuse throughout the upper districts. It grows faster than Juniperus Virginiana, but not so fast as Cupressus lusitanica.

Thuya gigantea (Thuya Lobbii), the *Yellow Cypress*, also *Oregon Red Cedar*, and *White Cedar* (Fig. 29). A tree of enormous dimensions, growing from Northern California northward, and entering largely into the domestic timber supply where it occurs. Though coming from a region having a colder and more snow-clad climate than that of Natal, this

tree has done well wherever it has been tried in the Midlands, and is an ornamental tree of fairly rapid growth.

THUYA OCCIDENTALIS, the *Northern White Cedar*, is also from North America, and has not been tried here; it succeeds in England as a small ornamental tree in many varieties.

Thuya dolabrata (Thuyopsis dolabrata), a fine tree in Japan, has been in cultivation here for some time, but gives little promise of success.

THUYA ORIENTALIS.—*Arbor-vitae* (Fig. 41). A small tree or shrub from China and Japan. Grown extensively here and throughout the Cape Colony as a hedge plant, usually with good effect, the compact little plants forming one of the neatest hedges we have. From seed it varies immensely, both in colour and form; in Europe these variations are perpetuated by cuttings, but here only seedings are used. In planting a hedge, however, it is best to select plants having the same general appearance, and especially the close, compact form known as *compacta*, which also makes a very neat specimen by itself (Fig 33)

LARIX is a small northern genus, producing resinous, durable timbers. In appearance they resemble Cedrus, but the foliage is deciduous. Larix Europaea, the European Larch, has been often tried, but without success here, and in Cape Colony I only know of two good specimens growing in deep soil in a high cold district.

Larix Griffithii, *Himalayan Larch*, and Larix leptolepis, *Japanese Larch*, may possibly exist, other species have little chance even to live coming from the far northern regions.

Taxus, the *Yew*, has been occasionally introduced, and continues to live, but its growth is so slow that its cultivation, except as a curiosity, is without object.

Cephalotaxus. Trees and shrubs from Japan, China, and India, not yet introduced here, and probably of little value even if they were. They resemble *Yews* in appearance.

Ginkgo biloba (Salisburia adiantifolia), a large tree in its home in Japan and China, and wherever it succeeds in cultivation, has not as yet been successful in Natal. It is deciduous, with curious fan leaves, but has regularly made a wretched appearance and poor growth.

PODOCARPUS (Nageia) is the genus to which our indigenous Yellow-woods belong, as well as several other highly valued timbers, including the *Totara*, Podocarpus totara, one of the most valuable timbers of New Zealand. The indigenous species are:—

Podocarpus elongata, *Outeniqua Yellowwood*.

Podocarpus Thunbergii, *Common Yellowwood* (Fig. 86).

Podocarpus Thunbergii var. falcata (Fig. 94).

The cultivation of these for timber is too slow to be profitable, but all three are distinct and ornamental in appearance, and grow fast enough to be used for this purpose, variety falcata being without any equal in its own habit, and one of the

most graceful trees in existence, alike in its younger stages and in its mature condition

The exotic species require trial before they can be recommended. For Cedrela see Chapter 19.

CHAPTER XVIII

DECIDUOUS TREES.

Paradoxical as it may appear, Natal is not well adapted for deciduous trees. Its indigenous tree flora contains only a few such, and these, like the Kaffirboom (Erythrina), Wild Chestnut (Calodendron), Sneezewood (Ptaeroxylon), Camdeboo Stinkwood (Celtis), and Corkwood (Commiphora), have a tendency to retain their leaves under favourable conditions. One would expect that the dry, hard winters would make deciduous trees more at home than evergreens, especially broad-leaved evergreens, but it is not so, probably on account of the spring coming and demanding a heavy water-supply before such supply is available. Indeed, with the exception of the common hardy fruit trees, Apples, Pears, Plums, Apricots, and Peaches, which adapt themselves to almost any climate, deciduous trees must be classed as disappointing. Of course, differences occur among them, but the general tendency here is for evergreens, even broad-leaved evergreens, to do better than deciduous trees. The deciduous tree seems to be a provision against cold, the fallen leaves protecting the roots while the leafless branches have only a limited sap-demand. But here there is no snow to fix and decompose the fallen leaves, they are blown away from the parent tree, and the fibrous roots, which are accustomed to work in or just below the humus, become dried out by the excessive insolation, and fail to keep even the leafless tree supplied with moisture.

We have looked mostly to Europe and the Eastern States of North America for such deciduous trees as we have; in both these cases they are accustomed to cold, moist winter and spring seasons, conditions almost the reverse of those prevailing here, consequently little surprise need be felt that they are more often failures than successes. Only in the deep shelter of slopes facing south or east can these trees be expected to do well, and unfortunately they seldom get that aspect. From a landscape point of view the ever-changing hues of deciduous trees make them desirable features dotted here and there among evergreens, but for the production of timber only a few can receive much recommendation. And many growers rather object to the litter they make by their shed leaves as winter approaches, as also that they lose their leaves just when protection against winter winds is most wanted.

Perhaps the greatest favourite everywhere is the *Weeping Willow*, Salix babylonica (Fig. 31), a tree which in its pendulous habit assumes a character not met with in any other

tree we have. The *Weeping Willow* forms a large tree rapidly; its cultivation is easy by means of cuttings, either large or small, and when felled it coppices again freely, whatever its age. It is less common on the coast than up-country, though it succeeds in both localities, but in the latter, especially in the Transvaal high-veldt, it is largely used as a fencing pole, living truncheons 5 to 8 inches diameter being used set two feet in the ground, and with 4 to 6 feet above ground. These invariably grow, producing lines of most ornamental trees, grand as shade for the cattle in summer, a beautiful feature in the landscape, and, on account of being alive and sappy, practically indestructible by any ordinary grass fire, at least if any precautions have been taken. It prefers to overhang water, at the side of a dam or stream, and is most vigorous and ornamental in such a site, but up-country it usually does well without this, but is pruned to a regular height by cattle browsing all they can reach. It stands pollarding and pruning, and can thereby be brought into any desired shape, the most common one being a broad umbrella-top. The seed is very small, and enveloped in wool, and it is consequently difficult to separate, or to germinate in its wool. The timber makes a splendid fuel, burning even when green. It has occasionally been used as naves, cart and wagon-flooring, and brake blocks, and has been asked after for match-making, but being scattered over the country, and usually branched to some extent, its technical value is seldom realised. There are several arborescent willows in Europe, of which some of the best are S. alba, S. russelliana, S. fragilis, and S. caprea, all somewhat similar in their requirements and products, but varying more or less in the colour and strength of their timbers. These are not in use here, but S. Babylonica is larger, and if well grown with clean boles answers most purposes equally well. In Europe Willow timber is preferred to Poplar for many technical purposes, being dented but not split when struck, which renders it particularly suitable for flooring, and for flooring for carts, waggons, and railway trucks, where cases and goods are being roughly handled. It is light (28 lbs. per cubic foot), tough, elastic, and durable, and consequently is preferred for cricket bats, for which purpose long prices are paid for selected pieces without knots or flaws, and it is also used for small fancy ship-building. It is much used for making charcoal, and for barrel-hoops. In America Willow-timber is planed into spells for punnet and basket manufacture.

Many of these larger kinds might with advantage be introduced here for varied scenic effect, and in fresh but moist vley lands are sure to do well. The only native arborescent Salix is S. capensis, Thb., a small tree frequenting river banks throughout South Africa, a good contrast in foliage to S. Babylonica, but seldom found away from streams. There is also a smaller shrubby species in Natal.

But there are several introduced Osier-willows, smaller than the timber-kinds already referred to, and useful principally for the production of Osiers for basket making and basket-chair manufacture. This industry has never taken a hold in Natal, the quantity of osiers available being limited, while those holding them find difficulty in getting skilled coolies willing to purchase what they have. There is a considerable demand for basketware, and the industry should be remunerative if worked systematically. There are many vleys suitable, with a little drainage, for osier-culture, both on the coast and up-country, the osier requiring very wet but not stagnant situations. Many varieties are used for this purpose, S. viminalis being the most common one here. S. amygdalina, S. purpurea, and others are also used in Europe, and are on trial here meantime. There are altogether over 200 species of Salix, ranging in size from 3 inches to 100 feet in height. The osier-willows are mostly small trees, which produce numerous strong pliable coppice shoots on being cut to the ground, and in the neighbourhood of London are considered very profitable farming, and well worth enormous quantities of manure to produce annual crops of osiers.

POPULUS yields a light, white, soft timber, of the same nature as that of the Willows, and used for much the same purposes, especially for flooring and waggon and railway truck flooring, on account of its ability to stand dents without splitting, and for packing cases, where its lightness and ease of working render it very useful. There are several species, of which the following occur here:—

POPULUS ALBA.—*White Poplar.* Abundant throughout South Africa; in Natal more frequent up-country than on the coast. It grows into a fine clean-stemmed tree on deep alluvial rather wet soil, and can stand more root moisture than almost any other tree, including brack and clay situations. It suckers very freely, and in the upper treeless districts its sucker-poles, though not durable, are in demand for native huts, sheds, etc. It is the most common street tree in the old Dutch towns, but its tendency to sucker in gardens and under buildings, and to shed its leaves into guttering and water-furrows rather spoils it. An evergreen variety exists in Aliwal North and elsewhere.

The foliage of the White Poplar is silvery white, and the stems white; in wet marshes it forms a dense thicket of sucker-growth, where no other tree would grow. It does not mix well with other trees, requiring too much space and moisture, but does well under irrigation, and near dams in the driest parts of the Karroo, where this and the Willow and Cypress are almost the only trees. Often used for live fence-poles, where grass fires destroy Sneezewood and other inflammable poles. The timber is not much used here, but in Europe is in demand for flooring, turnery, matches, and paper-pulp. Does not strike readily from cuttings, but is easily

propagated by suckers. In "Forestry and Forest Products" it is stated:—"The only other wood besides Pine and Fir used largely in Europe (for pulp-making) is Aspen or Poplar. It is dearer in Norway and Sweden than Pine wood, on account of the demand for it in the manufacture of lucifer matches. The fibre produced is short and tender, but much whiter than Pine fibre, hence a higher price is obtained for the ground wood."

POPULUS NIGRA.—*Black Poplar.* Less common than the White Poplar; somewhat similar in habit and in habitat; usually found up-country in moist alluvial soil, and sometimes forming fine trees. Suckers, but not so freely as the White Poplar. Timber is fit for the same purposes as that of that species.

POPULUS FASTIGIATA.—*Lombardy Poplar* (Fig. 32), is considered by some to be a variety of the Black Poplar. It has a close upright habit, reminding one of the Cupressus pyramidalis, long lines of it keeping very equal growth and forming a tall narrow formal hedge if closely planted. It requires less moisture than P. alba, and is often used as a shelter for orchards in high exposed localities, though it requires to be at some distance from the fruit trees. It seldom, if ever, seeds, but propagates easily from cuttings, whether large or small. Timber light, long, without high diameter, and consequently in demand for scaffold poles of 60 to 70 feet length. Used also for gate bars and other domestic purposes, but seldom for technical uses.

POPULUS CANADENSIS (P. monilifera), Cottonwood. A large tree of very rapid growth on deep alluvial land, soon forming timber which is light, soft, and easily worked. In North America it is in demand for boards and for housebuilding, as it does not readily burn, and for cases and paper-pulp. Of comparatively recent introduction here, but the best species we have for timber production. Strikes easily, and does not sucker to excess. Several other species may be worth introduction.

QUERCUS ROBUR, VAR. PEDUNCULATA.—*The Oak* (Fig. 31). This tree, which is of high importance in European forestry is less regularly successful here, and can hardly be considered one of our most important forestal trees. It is, nevertheless, often a success, and where this is the case it forms a grand and distinctive feature in the landscape, especially if standing alone. The Oak requires deep soil, alluvial by preference, constantly more or less moist, and never wet. Where it gets this it grows into a fine tree, but almost invariably what are now old trees have been planted too sparse, and are consequently heavily branched, and thereby spoiled for technical purposes. If the branches have been removed after attaining considerable size fungoid decay usually enters and destroys the bole. The best way to grow Oak timber is, therefore, to plant trees or

sow seeds closely, say, 3 feet apart, and allow the trees to remain at this espacement till side branches have disappeared, and tall, straight, clean stems are produced, thereafter thinning as necessary, but leaving the trees sufficiently crowded to keep them upward without heavy branches. Self-sown seedlings under or around an old tree usually have better form forced upon them in this way than the parent had.

Acorns are freely produced on trees ten or more years old, but are often shed prematurely, and even if ripe only a small percentage obtain conditions favourable for germination, the balance perishing soon unless eaten up by the stock or pigs. Sown artificially immediately after they ripen every acorn grows, if sufficient care has been exercised in the collecting, but if bagged fresh and left in sunshine they heat within a day, and lose vitality if left in that condition for several days They are, therefore, difficult to transport unless carefully dried under cover, or sent in small quantities. Many tons are used in the Cape for cattle and mule feed, and also for mixing with coffee.

The Oak does best in the higher districts, where snow-rains help to keep it moist during winter and spring. In the Midlands it requires deep open soil and vley conditions, but with a ditch at hand to prevent saturation, and it dislikes a clay subsoil close at hand. In Maritburg it is usually stag-headed, in some cases through shale subsoil, in others through drought caused by street formation, and frequently through being defoliated year after year by the caterpillars of a large moth. There are fine trees at Nel's Rust and at Greytown, but it is less happy towards the coast. At Hilton there are trees about 40 years old, and seedlings from these all planted too sparsely, and now another generation of self-sown seedlings is coming on, but grown as these have been the Blue Gums and Cypresses near them are both of more value. At Acton Holmes, and along the Berg they do well. Where late spring frosts occur there is a tendency to get into leaf too early, and get frosted. The tree grows much more rapidly here than in Europe, and if grown systematically for timber would doubtless yield good, clean material of less density and value than British Oak, though I am not aware that its timber has been tried here. In view of the other hardwoods which grow naturally, or can be cultivated, it is doubtful if the Oak is worth attention as a forest tree. As an ornamental tree, however, it is well worth a place, and cattle like its shade and prune it up as far as they can reach.

The bark is used in England for tanning, but is not of high enough value to make shipment from here practicable.

QUERCUS COCCINEA, the Black Oak, is a North American species, making growth here about equal to the British Oak. A variety of it, known as the *Scarlet Oak*, has its foliage highly coloured scarlet while being developed in spring, and also takes

bright autumn tints. A good specimen of this variety stands in Wilkinson's Nursery, Town Bush Valley. The timber is considered less valuable than that of British Oak. There are many other Oaks, mostly American, worth introduction as ornamental trees. Some evergreen Oaks are referred to in next chapter.

PLATANUS ORIENTALIS, *The Plane*, and Platanus occidentalis, *The American Plane.* These form fine shade trees where they succeed, but their success in Natal can only be described as moderate. In a few Midland localities fairly good specimens are to be seen, but more usually the Plane stands leafless half the summer as well as all the winter, being easily affected by unduly hot summer days. It requires a deep, open moist alluvial or chocolate soil, preferably on a river bank, or southern slope, and does better at or above Maritzburg than toward the coast. In Europe, Asia, and North America the Planes yield furniture and turning timber, but they are only shade trees here. The foliage is a bright glossy green, and highly ornamental. Seeds do not readily germinate, so propagation is usually by cuttings of half-inch to one-inch wood from near the root; indeed, stools kept coppiced annually yield the best cuttings for striking.

LIRIODENDRON TULIPIFERA, the *Tulip Tree* (Figs. 32, 79, 82). This fine tree is perhaps the most successful deciduous tree in Natal. Old trees are scarce, but the many young trees are all doing well, where planted on deep open soil, and making growth as rapidly as the Poplars. It is a native of the Eastern United States and Canada, and is known there as Tulip Poplar, its timber being largely used and exported as Poplar timber, American Whitewood or Canary Whitewood, to Europe. From such a locality, however, a cold and wet climate would be the most suitable for it, and in the absence of that a site where the soil keeps moist during winter is naturally the best, though it does not like stagnant moisture. Around Maritzburg it does well, and in suitable localities might even be grown as a timber tree, though it is as an ornamental tree that it is best known, the effect when the young foliage appears in spring, and when the tree is in flower, being very fine. As it develops a taproot it transplants most easily when young, and its growth at first is rather slow. Usually grown from imported seeds, which do not keep long, and germinate irregularly for a year or more. In European and American nurseries the seeds are stratified for a year. Stevenson says (Trees of Commerce):—"Its comparative rareness in the maritime parts of the Carolinas and of Georgia, in the Floridas and in Lower Louisiana, is owing less to the heat of summer than to the nature of the soil, which in some parts is too dry, as in the Pine barrens, and in others too wet, as in the swamps which border the rivers."

Concerning its timber Mueller states:—"The Tulip-wood is highly esteemed and every extensively used, wherever this

tree abounds, uniting lightness with handsomeness. It is of a light yellow colour, fine-grained, compact, easily worked, and takes a good polish. It is employed for house building inside, for bridges, cheap furniture, implements, shingles, pumps, wooden-ware, boat-building, and a variety of other purposes. On account of its uniformity and freedom from knots, and its disinclination to warp or shrink, much used in Canada for railway cars and carriage building, chiefly for the panelling. The bark yields about 8 per cent. tannin." Stevenson states:—"The timber, though classed among light woods, is much heavier than that of the common Poplar; its grain is equally fine, but more compact, and the wood is easily wrought and polished. It is found strong and stiff enough for uses that require great solidity. . . . . At New York and Philadelphia, and in the adjacent country, it is often employed in the construction of houses, for rafters, and for the joists of upper stories. In the other middle States, and in the Western States it is more generally used in building and is considered as the best substitute for the Pine, the Red Cedar, and the Cypress. Wherever it abounds, it serves for the interior work of houses, and sometimes for the exterior covering, the panels of doors and of wainscots, and the mouldings of chimney-pieces. . . . . In all the large towns of the United States Tulip or Poplar boards are used in widths of 2 to 3 feet. When dry it takes the paint or polish remarkably well. The seats of the American Windsor chairs are invariably made of this wood. It is also used for trunk and box making, for furniture, agricultural implements, turnery, broom heads, etc."

Concerning the timber as imported into Britain, he says planks command a price fully equal to that of first quality Quebec yellowpine, and adds:—"The uses to which this fine wood is applied are legion, and it is rapidly becoming a factor in the wood trade of this country," and still for the decorative use of the tree as grown in Europe he says:—"Every possessor of a tulip tree in Europe values it far higher for its beauty in a living state than for its products."

In Natal this also holds good.

ACER PSEUDO-PLATANUS.—The Sycamore, is a large tree of middle and south Europe, its timber being applied there to an immense variety of purposes. Here its growth is usually slow, and though it can be recommended for variety in a collection its growth for timber purposes must be confined to moist, cool upland places, if taken up at all. It grows well, and seeds freely, with Mr. King, at Lynedoch. Unless crowded, or pruned it forms a heavily branched tree with a good spread, fit for avenues or single specimens.

ACER NEGUNDO (Negundo aceroides), the *Box Elder* (Fig. 29), grows better in Natal than any of the other Maples, but though fit for use as a shade tree or ornamental specimen where the soil is deep alluvial, its growth for timber cannot be recommended.

ACER SACCHARINUM (Wang), the *Sugar Maple*, has been tried here, and though it lives it cannot be said to be a forestal success, nor is this to be expected of any of the Acers (of which there are many), almost all of which enjoy naturally severe winters, abundant moisture in spring, and deep alluvial well-drained soil. Such conditions, if they exist here in selected spots, are worth better trees than the Maples, whose growth for timber cannot be recommended, though they are largely utilised where they occur naturally, especially in the United States. The foliage effects obtainable from among the Maples are, however, very effective, especially autumn tints, which in some species are bright scarlet, while there are also several very pretty variegated species or forms usually propagated in Europe by grafting on a more common kind. Japan yields many beautiful species, which are more likely to succeed here than the North American or European kinds.

ULMUS CAMPESTRIS.—*The Elm.* Although the Elm likes deep alluvial soil, it is less difficult to please than most other deciduous trees, and consequently is often more successful, especially in the middle and upper districts, though few large trees exist in Natal. It requires a moist spring to bring it out well. It is easily propagated by cuttings, and some varieties sucker freely. There are several Elms grown in Natal, including one drooping variety, which does best grafted on a high stem of the Common Elm. I am not aware of the American Elm having been tried, or of any of the Mexican species, which are more likely to do well than the Northern kinds. Where the Elms grow wild their timber is considered very valuable, and used for a great variety of purposes, but the use of the tree here is mainly for ornament.

CATALPA BIGNONIOIDES (Fig. 32) and Catalpa speciosa are being cultivated to an enormous extent in some of the Western United States, and where winter and spring rains are available appear to grow rapidly, and eventually yield an indestructible timber, useful for railway sleepers and many other purposes. Here, however, climatic conditions are against the Catalpa, and though it is well worth growing as an ornamental tree, its growth has, nowhere in South Africa been sufficient to justify its being planted for timber purposes. The foliage is large and massive, but easily affected by excessive heat.

AILANTHUS GLANDULOSA.—(Figs. 35, 55) has striking foliage, the pinnate leaves being sometimes two feet long. As a young and vigorous tree on deep soil it is very ornamental, but as an old tree it is a failure here, producing no timber, and having no ornamental effect, while it suckers all too readily. In winter rainfall countries it is used as a street shade tree, and yields a durable useful timber.

AILANTHUS IMBERIFLORA.—From Queensland, has not been tried, but may prove worth growing.

JUGLANS REGIA.—*Common Walnut,* is grown as a fruit tree in deep open soil in the middle and upper districts with a fair amount of success. That is, it grows rather slowly into a large spreading, much-branched tree, bearing heavy crops of fruit. But its fruit, though used, is seldom equal to the selected varieties of the same species propagated in Europe by grafting, and which are not here yet, while its branches are so crooked that they can hardly come in as timber. In Europe the fruit product is enormous, but the timber also comes largely into commerce, Walnut-wood being much in demand for the finer classes of furniture manufacture. Here the timber of Blackwood (Acacia melanoxylon) is likely to take its place for such work when a demand sets in. The Walnut prefers lime in the soil, a moist open river-bank, a cold winter, and to be surrounded by other trees.

It forms a large taproot, which is often damaged in transplanting, and it does not readily form many fibrous roots, consequently trees sown where they are to remain do best.

JUGLANS NIGRA.—The *Black Walnut* (Fig. 39), is a timber tree rather than a fruit tree, and grown as such in the indigenous forests of Eastern North America it supplies a very large proportion of the hardwood-furniture timber there. Its growth here, like that of most other trees from the same region, has been rather disappointing; it lives, but it does not flourish, except in a few select localities. Does fairly well in Durban and Maritzburg. It requires close pruning or interplanting to keep it straight.

JUGLANS CINEREA. The *Butternut,* has not been largely tried, but the same absence of success may be expected as usually attends North American trees from winter rainfall districts. Its timber is of the highest utility. More success may be expected from J. californica, or the Japenese J. sieboldiana, J. cordiformis, and J. Mandschurica, not yet tried here.

Carya has many species, native to the United States and Canada, yielding Hickory and Pecan nuts, and all valuable timber trees there, hickory spokes and wagon-wood forming an important article of import here from North America. As the Hickories require winter and spring rainfall little success can be expected from them here, and their culture as timber-trees is not likely to succeed. Sir G. Sutton grows and fruits several species at Howick. C. alba is the common Shellback Hickory. C. oliviformis, the *Peccan,* has a wider range than the others, extending to Texas, and its prospects of success here are better. It yields a first-rate heavy, strong, elastic timber, and is also being cultivated largely in California by seedlings and budded trees for its nuts, which are in high demand.

All the Caryas are slow growing at first, and rather difficult to transplant, forming taproots at an early age.

FRAXINUS EXCELSIOR.—The *Ash*, has been tried in many sites and situations, but I have still to see the first really successful specimen in Natal of this or any other Ash. They live and make reasonable growth for true exotics, but there is nothing satisfactory about their growth, nor anything which would lead to high hopes of a timber future for them here. There are many species, including some from Texas, Mexico, the Himalayas, and Mediterranean, which may be worth further trial wherever there is moisture in spring, but cannot be recommended without that trial.

The seeds of Ash do not germinate quickly, except F. ornus, the *Manna Ash*, that of most of the other species having to be stratified for a year, and then sown. All, however, strike from cuttings of inch wood.

ROBINIA PSEUDACACIA.—Sometimes known as the *White Acacia*, is a large North American leguminous tree, producing nearly imperishable heartwood, and in its native country used for fence poles and many other domestic purposes. Here it does fairly well in the midland and upper districts, forming rather a low, much-branched tree, with a stem up to 12 or 15 inches, and probably with age it might increase in size. In the Orange River Colony and upper parts of the Cape Colony it is often used as a street tree with good effect, benefiting by the irrigation furrows which usually traverse the streets of these dorps. Without irrigation the dry spring season harms it. The flowers are sweetly scented, and when in flower the tree is very ornamental, but its value as a timber tree here has still to be proved, other more rapid kinds answering most local purposes as well. It is apt to lag at the start, and where that happens the trees should all be cut close off at the ground when two or three years planted, and only one coppice shoot allowed to grow on each, which will then grow vigorously, and make the foundation of a good tree. It grows easily from soaked seed, and also from transplanted suckers. On the coast it is not worth growing.

GLEDITSCHIA TRIACANTHOS.—The *Honey Locust*, is another American tree somewhat similar in nature to the Robinia, and about equally successful, being good in deep alluvial soil, or under irrigation, but useless where spring drought tells. Where satisfactory it forms a fine clean-stemmed tree with a spreading crown, its long black pods forming a feature sometimes after the leaves have fallen. Succeeds occasionally in the Yellowwood belt, seldom elsewhere.

LIQUIDAMBER STYRACIFLUA.—The *Sweet Gum Tree*, another large North American tree, is pretty and maple-like while young, but has not yet reached maturity here, and cannot be said to be proved. The timber is a heavy, durable, pretty furniture wood.

MACLURIA AURANTIACA.—The *Osage Orange* (Fig. 78), is another North American speces, good enough for rough hedging, for it is very prickly, but seldom worth culture as a tree.

It is dioecious, forming a low spreading tree, yielding very hard, tough, elastic durable timber. It grows in Maritzburg, Ladysmith, and further upcountry.

Melia azaderach, the *Syringa*, is the most abused tree we have. It occurs everywhere, and is always so chopped and knocked about that a good log can seldom be seen, and yet, when found, it yields a beautiful furniture timber, fit also for yokes, door soles, etc. It grows rapidly on good depth of soil into a fine shade tree, the whole neighbourhood being scented in spring by its delicious flowers, which are too fragrant for some individuals. Often used for rough hedging or shelter, especially by the Indians along the coast, but also in the upper districts and Transvaal. The seeds contain an oil, which it has not been found profitable to express as yet, but they also have the reputation of being poisonous to some classes of stock, probably only when eaten in excess.

It varies considerably in colour and vigour, some variations being considered species or subspecies. M. Indica, also growing in the Durban Botanic Garden, is the Indian *Nēēm* tree, considered in India a fine shade tree, useful furniture timber, and favourite food, medicine, etc., of the natives. It has still to prove its utility here.

MORUS ALBA.—The *White Mulberry*, or *Chinèsè Mulberry*, is common as a rough hedge throughout Natal, and often by neglect allowed to grow into a tree. It is the species usually used here by children for feeding their silkworms, and extensively used elsewhere for the same purpose, though other species of Morus, as well as trees of other genera, are used for the same purpose.

The large-leaved species of Mulberry make very nice shade trees, having a spreading crown with only sufficient stem to allow clear space for passengers below. Though not often used for the purpose, it is more suitable for a street tree than some of the tall, upright Eucalypts and Cupressus often used. Gamble states that the wood is good, and used for building, boats, furniture, and agricultural implements in India. The tree seldom reaches timber size here.

MORUS NIGRA.—The *Black Mulberry*, does well in the irrigated gardens and streets of Karroo villages in the Cape Colony, but seldom does so well where rain alone is relied on, and seems less happy in the more coastward districts. It does not readily grow from cuttings, as the other Mulberries do, and is therefore usually increased by grafting on to one of the other species. It yields a delicious fruit, well worth cultivation, and has not been noticed in Natal.

The various Mulberries are used in India as timber trees, but through dissemination by birds M. indica has proved rather a weed in plantations planted with other trees.

M. CELTIDIFOLIA and M. RUBRA are Mexican timber trees, probably worth trial here.

M. SERRATA and M. LAEVIGATA are large Himalayan trees not in cultivation here as yet.

CELTIS OCCIDENTALIS.—The *Hackberry* of N.E. America, Celtis australis, the *Lotus-tree* of Europe and Asia, Celtis sinensis from China, and C. Sellowiana, and C. Tala from South America, all closely resemble in general appearance the indigenous Celtis Kraussiana (*Camdëboo Stinkwood*), but have slower growth, and possess no other quality to recommend them in preference to that tree, which, on good ground, is distinctly the most successful deciduous tree we have, and might take the place here as a street tree or for general ornament, of the Elms so much used in Europe and North America.

CASTANEA VESCA, the *Sweet Chestnut*, has been tried in many South African localities without yet being a proved success in the dry-winter districts. It continues to live, often to 20 or more years, and is most ornamental when in good foliage, but except in a few particularly favourable sites has remained bushy and undeveloped, fruiting prematurely, but giving no promise of being ultimately a timber tree. It gets bark-bound during the dry season, and then coppices rather than makes top growth. It likes deep alluvial soil, and would probably do well in the Natal Midlands if naturally moist, but not wet, spots were selected, or if it were irrigated during winter and spring. Without that it will never do much even as a fruit tree. It can be propagated by seed, or by striking coppice shoots from the base of the stem.

BETULA ALBA.—The *Birch*, is an ornamental tree where it succeeds. It does not easily germinate, requiring skilled nurseryman's treatment, but, once up, it grows well, even in the Eastern Province, Cape Colony. I am not aware of any trees of it in Natal.

There are several other species of Betula, mostly North-East American, and therefore not likely to succeed here except as ornamental trees.

ALNUS GLUTINOSA.—The *Alder*, is easily raised from seed, but remains afterwards a small stunted bush in South Africa, very unlike the tree it makes in Europe and Asia. There are other species, North African and South Asiatic, from among which some may be climatically more suitable.

FAGUS SILVATICA.—The *Beech*, is one of the most pronounced failures we have had, growing only a few feet during many years. The Purple Beech is equally slow, and is replaced here by Prunus pissardi, which, though not so good in habit, is equally effective in colour. The Australian and New Zealand Beeches are more likely to succeed, but have not yet been tried. They are fine timber trees.

ÆSCULUS HIPPOCASTANUM.—The *Horse Chestnut*, is another complete failure here. The seed usually perishes before it can reach this, but when trees have been imported they have either died, or continued to live in miserable condition, the dry winter and spring being too severe for them.

TILIA EUROPAEA.—*The Linden*, is another failure, and for the same cause. Its leaves are also too tender for local sun-conditions. There are several species of Tilia, but success is not expected from either.

CARPINUS BETULUS.—The *Hornbeam*, is a useful timber tree in Europe, but has not been a success here. Japanese and Indian species may do better.

CORYLUS AVELLANA.—The *Hazel*, *Cobnut*, *Filbert*, and *Barcelona Nut*, is not a timber tree here, and can only by careful selection of locality be kept alive as a nut tree. It requires moisture and coolness, such as can only be got in mountain kloofs, or in the Yellowwood forest glades. Asiatic species may be better worth trying. Some other deciduous trees will be included in the next Chapter; deciduous Conifers were included in the last Chapter.

The Apple, Pear, Plum, Peach, Fig, Cherry, and other deciduous fruit trees, in doing fairly well throughout Natal, are exceptions to the general rule that deciduous trees are not the best suited for the local climatic conditions. Often they receive cultivation, and even irrigation, which, if judiciously used, helps them, but even without these they show a wonderful adaptability, which allows their use in many places where otherwise there would be no trees of any kind.

In some upland localities Peaches and Apples are grown more with a view to fuel than for fruit, and they stand very severe treatment, showing remarkable vitality.

CHAPTER XIX.

MISCELLANEOUS TREES.

There are still a good many trees worth mention which have not fitted in well with any of the previous Chapters, and are therefore brought together here without any other connecting link.

ALEURITES TRILOBA.—*Candlenut Tree* (Figs. 47, 81), an ornamental tree of rapid growth to large dimensions, but without value for timber purposes, the wood being, according to Sebert, "white, soft, light, and of bad quality, with an average weight of 38 lbs. per cubic foot." The foliage, which is dark-green, resembles that of some of the larger exotic Figs, and the tree bears in profusion the *Candle-nuts*, or *Belgaum Walnuts*, from the edible kernels of which, in India, according to Gamble, "a useful oil can be expressed and used for illumination, and as a drying oil for paint, for which purpose it has been said to equal linseed oil." Mr. J. Medley Wood says in the "Guide to the Natal Botanic Garden, Durban,:—"The fruits contain a large quantity of oil, and have a value in the Home markets. The natives of the country where it is indigenous, thread the fruits on straws, and use them as candles or torches, hence the popular name." In his report, 1901-2, however, doubt is thrown upon the Home value. Recently the Colonial Institute claimed the dissemination of this tree throughout the Colonies as a proof of the usefulness of the Institute; I am now making enquiries as to whether the tree has a value for this Colony, apart from its ornamental character. It grows rapidly along the coast and inland as far as Maritzburg; it fruits very freely, and if its fruit has a sufficient value the tree may take the place in coast forestry, especially in Zululand, that the Wattle holds in the midlands. But the value has to be verified before planting can be recommended except for ornament and shelter. It makes a fine specimen tree.

ALBIZZIA (Pithecolobium) is a genus of deciduous leguminous trees found more or less throughout the subtropics, and represented in the indigenous flora of Natal by the Flat-crown. Several of the trees yield valuable timbers, others are used as "nurse-trees" for coffee and tea, and others are grown for the flower and foliage effect. Most species inhabit rather hot, dry Indian plain country, rather than heavy forest, and this character ought to be of use in trying to introduce them here; several also are maritime. The species growing in the Durban Botanic Garden are: A. amara, A. fastigiata, A. Lebbek,

and A. procera; concerning the latter Mr. Wood reports 35 feet height and 3 feet 7 inches in circumference in 18 years' growth.

Albizzia Lebbek, the *Siris*, is a large tree from the Sub-Himalayas, Southern India, and Ceylon, forming an important item in Indian forestry, and likely to be of use in the Zululand coast district, though its growth in Durban has not been promising. Gamble states concerning its presence in India: —"This *Siris* is one of the best known of Indian trees, as it is not only very common in forests almost all over the country, but is largely cultivated as an avenue and garden tree. When in flower it is pretty, and some people may like the rather sickly scent of the blossoms, but in the early hot season, when its leaves are gone, and the yellow persistent pods rattle with every puff of the hot wind, it is not beautiful. The wood varies greatly in weight and strength, as is obvious from the list given below (42 to 61 lbs. per cubic foot), but it is very useful, and of late years a considerable amount of it has been exported to London from the Andamans. The 'burrs' are especially valuable, and fetch ten to twenty times the price of the plain wood. It is probably the 'East Indian Walnut' of the European market. The logs cut in the Andamans give squares up to 50 feet long with 3 feet siding. It is very easily propagated, but if grown alone as in avenues requires very careful pruning, or it will branch low down, and not make a handsome tree. It is much planted along embankments in Burma. . . . . The wood seasons, works and polishes well, and is fairly durable. It is used for sugar-cane crushers, oil-mills, furniture, well-curbs, and wheelwork; in South India for boats. In the Andamans, where trees of large size are procurable, it is used for building, but more usually for house-posts. It is often grown as an avenue tree, but its roots do not penetrate very deep. It grows easily from cuttings. It gives a gum which is not soluble in water, but merely forms a jelly. The leaves and twigs are given as fodder to camels." Used as an avenue tree in Cairo.

Albizzia procera.—*White Siris*, is also a large tree from the same geographical area, also used as a timber, avenue, and garden tree, said to grow faster than A. Lebbek, and to endure brack soil. Concerning its timber Gamble states:— "Wood hard, sapwood large, yellowish white, not durable; heart-wood brown, shining, with alternate belts of darker and lighter colour; very like that of A. Lebbek, and often indistinguishable from it. . . . . The wood is straight and even-grained, seasons well, and the heartwood is durable. It is used for sugar-cane crushers, rice-pounders, wheels, agricultural implements, bridges, and house-posts." Splits well, and makes excellent fuel. Propagation by seed; habitat low lands near river banks. Apparently the right tree for the Zululand swamp district.

ALBIZZIA SAMAN (Pithecolobium saman).—One of the most rapid growers in existence, favouring the coast, from Mexico to Brazil. Timber soft and worthless, pods used as cattle feed. Not yet tried here, but worth trying for ornament in Zululand.

ALBIZZIA LOPHANTHA (ACACIA LOPHANTHA.—A rapid-growing Australian Wattle, very ornamental when young, straggling when old, never a tree, and absolutely useless for timber. Caused great disappointment in the Transkei through having been sown in error instead of Black Wattle, and tried as a hut wattle, decaying almost at once.

ALBIZZIA JULIBRISSIN.—*Pink Siris*, an ornamental red-flowered tree, well worth cultivation for ornament on the Coast.

Several other Indian and Mid-American species of Albizzia may be worth trying on the Coast, including A. amara, concerning which Gamble quotes:—"The wood is strong, fibrous, and stiff, close-grained, hard, and durable, superior to Sal and Teak in transverse strength and direct cohesive power." For the indigenous Flat-crown see next Chapter.

ACHRAS SAPOTA.—The Sapodilla Plum, is a large West-Indian evergreen fruit tree worth trial in the moist belt between Eshowe and Entumeni.

AFZELIA AUSTRALIS.—Is a large Queensland hardwood tree, not yet tried here.

ARTOCARPUS INTEGRIFOLIA.—The *Jack Tree*, is not uncommon along the Natal coast, doing well, and lives as far inland as Maritzburg (Wilkinson's Nursery). At least two varieties—probaby more—are in cultivation for the enormous cooking-fruits which they produce from the stem; these may be varieties of integrifolia, or different species, as there are several species of Artocarpus, some fruit trees, others timber trees, others both, some deciduous, others evergreen.

A. INCISA.—The *Bread fruit tree*, is cultivated in South India, but considered less hardy there than the various Indian species. Concerning A. integrifolia, Gamble states:—"It is one of the most important of the fruit plants of India, probably after the Mango and Plantain the most important, and good trees are valuable. . . . . The average weight (of the timber) is probably about 40. lbs. It is very largely used for carpentry, boxes, and furniture, and is occasionally exported to Europe for cabinet work, turning, and brush backs." He also states that the tree requires a deep, moist, rich soil and heavy rainfall; that it has a long tap-root, and that seedlings require care in transplanting. The seeds are roasted and eaten like chestnuts, and the tree begins to fruit when 6 or 7 years old. An interesting article on the Jack is to be found in the report of the Natal Botanic Gardens, Durban, 1902-1903.

A. HIRSUTA.—Yields a hard, durable ant-proof wood, but probably requires more moisture than is available here.

A. CHAPLASHA AND A. LAKOOCHA.—Are both deciduous Indian species, yielding valuable timbers, the latter species also yielding an edible fruit. Both may be worth trial in the more moist parts of lower Zululand.

ANGOPHORA LANCEOLATA, A. intermedia, and A. subvelutina are Australian trees of rapid growth, resembling Eucalypts, but forming more ornamental shade trees, though probably yielding less valuable timber. They are in cultivation here in the Midlands, and do well, but are usually mistaken for Eucalypts, and require similar conditions. The timber is used in wagon work, that of A. lanceolata being preferred in Australia. I am not aware of the timber having been tried here.

ASPIDOSPERMA QUEBRACHO.—*Quebracho colorado,* or Red Quebracho. A tan extract made from the timber, bark, and leaves is shipped from the Argentine to Europe. Sleepers of Quebracho timber are indestructible. The tree is not in cultivation here as yet, but may succeed along the Zululand Coast, and it is evident that cultivation, even if slow, will pay better than collection from natural trees scattered at the rate of one tree per acre over a vast area, as appears from the following paper from the English "Journal of the Board of Agriculture" (December, 1904) to be the case:—

"Among the countries which compete with the home production of oak-bark are Argentine and Paraguay, which produce a valuable wood, viz., the Quebracho, from which tannin is obtained. In addition to producing tannin in its bark, like the oak, chestnut, and other trees, it also contains, like them, some in its sapwood, and stores it in a concentrated state in considerable quantity in the whole of the central part of the wood. According to Charpentier, its bark contains from 6 to 8 per cent. of tannin; the sap 3 to 4 per cent.; and the heart 19 to 22 per cent. As the heart of the Quebracho represents two-thirds, and often three-quarters, of the total quantity of wood, the amount of tannin contained in this variety is considerable. It is inferior, however, to oak bark tanning material, and it contains colouring matters which are difficult to separate. The importation of this wood, however, is probably one of the causes of the present unremunerative price of English oak bark.

"According to the Trade Returns of Argentina, the exports are chiefly made in the form of wood or of Quebracho extract. There is also an insignificant export in the form of coarse sawdust. The exports of Quebracho wood first began to assume importance in 1888, when some 7,000 tons were exported, and from that time they rose very rapidly till 1895, when they amounted to 170,000 tons. In that year, however, the tannin, in the form of extract, began to be exported, and this had apparently some effect in checking the rapid extension of the trade in the natural wood, which amounted, however, in the five years, 1899-1903, to an average of 200,000

tons annually. The exports of the extract increased from about 400 tons in 1895 to 9,000 tons in 1902, and 12,000 tons in 1903. The United Kingdom appears to be the largest consumer of the wood in its raw state. According to the Argentine returns, the quantity shipped to this country in the five years 1899-1903 averaged 140,000 tons annually. In the case of the extract, the United States and Germany appear as the principal purchasers, but some 1,400 tons came to Great Britain.

"Some information respecting this product was recently furnished in a German Consular Report,* from which it appears that there are two sources of supply; one including the Province of Santiago and part of the Province of Tecuman, and the other embracing the northern part of Santa Fe, and the banks of the Parana River. The former occupies a secondary position both as regards the amount of tannin in the wood, the density of the trees, distance from river ports, and other conditions. The principal source of supply forms the south-western part of the great plains known as the "Gran Chaco," which stretch northward from Sante Fe. The profitable exploitation of the Quebracho is at present restricted to the district opened up by the railway which goes from Santa Fe northwards to La Sabana, on the boundary of the Chaco territory. This railway runs through the Quebracho country for a distance of 40 to 60 miles parallel to the river, and has a branch line about midway, near Vera, to Reconquista, on the Parana River.

"The yield of Quebracho wood is estimated at an average of 12,500 tons per square league of 6,250 acres, or about two tons per acre. About 100 medium-sized trees represent the avearge crop obtained from 125 acres. In Paraguay the yield is somewhat more. As a means of transport there exist at present only the railway named above, and the Parana River, and distance from these commercial routes is a most important consideration in the development of the trade. The cost of transport becomes excessive when the distance exceeds 10 to 15 miles, as the haulage has to be done by oxen, and the roads or tracks are usually very bad. In order to shorten the transport, and free themselves from the railway monopoly, several firms are endeavouring to construct their own railway connection with the Parana ports. Particulars of the total extent of the Quebracho country are not available, but it is probable that large quantities of this timber exist, though at the present time only the smallest part is economically valuable, as the trees are so thinly distributed over great areas."

Mr. Hutchins states:—"A very valuable tree, but I fear slow growing. Said to take about a century to mature, when the average height is from 80 to 100 feet. Quebracho sleepers are almost imperishable as regards decay."

*Zeit fur Forst-und-Jagdwesen, August, 1904.

In answer to my enquiry, Professor Wallace, of Edinburgh University, who has just returned from inspecting the agricultural resources of Argentine, writes, under date April 12th, 1905:—

"Quebracho being very hard, as well as a most valuable timber, is slow of growth, and will assuredly be cut out in time if not conserved, which is practically impossible in a 'free' country like Argentine, and I would recommend its trial in South Africa. I think it would grow, and if successful in South Africa it would become a very valuable addition to the timber trees of the country. I do not know of its having been planted in South America, and I am pretty certain it is not cultivated, but found growing naturally in the wooded parts of the area which lie in the northern sections of Argentine, and the warmer and more humid areas to the north of it."

It should be noted that Loxopterygium Lorentzii also yields a tan produce shipped to Europe under the same name.

BAUHINIA.—A large genus, including trees, shrubs, and climbers, of very ornamental character, the flowers being usually large and attractive. Several shrubby species are indigenous to Natal, but well worth cultivation; one large tree is said to yield one of the best hardwood timbers of Rhodesia, several Australian species are known as Queensland Ebony, and yield hard useful timbers, while the Indian species, though used for timber purposes, are considered ornamental rather than useful. The following species are in cultivation in South Africa:—

BAUHINIA CANDICANS.—From Brazil, a large flat-topped tree, producing large white flowers abundantly during summer. Usually deciduous; thrives best on the coast and around Maritzburg. Produces suckers which can be transplanted.

BAUHINIA GALPINII.—A shrub from Barberton, producing large red flowers abundantly.

BAUHINIA PICTA.—A flowering shrub from New Grenada.

BAUHINIA NATALENSIS.—A yellow-flowered indigenous coast shrub; does well in selected localities as far inland as Tweedie Hall.

BAUHINIA BOWKERI.—A trailing shrub, native of the Transkei, producing a profusion of large white scented Azalea-like flowers.

BAUHINIA PETERSIANA.—A red-flowered shrub from Zambesia.

Bauhinia purpurea, an evergreen bush or small tree, from India, flowering abundantly from the coast to Maritzburg. Flowers pink to purple, fragrant.

BAUHINIA TOMENTOSA.—A yellow-flowered indigenous coast shrub.

BAUHINIA VAHLII.—A huge Indian monkey-rope, with large leaves and flowers.

BAUHINIA VARIEGATA.—A small Indian tree, producing useful timber, pods, and bark. Flowers with four white and one coloured petal.

B. ACUMINATA.—Is probably a white flowered prickly species cultivated under the name Mountain Mahogany.

BIXA ORELLANA. The Arnatto-plant, a small ornamental American tree, which fruits freely in Durban. The pulp of the fruit yields a red dye used for colouring butter.

BAMBUSA.—This genus, together with Arundinaria, Phyllostachys and Dendrocalamus, yeild most of the Bamboos of commerce. There are many species of Bamboos, some coming from almost every tropical and sub-tropical country. Some form huge clumps of gigantic stems, others are only small grasses a few inches high, and there is every intermediate gradation of size; some are quite hardy throughout Natal, others hardy in the coastward districts only, and probably some not hardy. Many kinds have been introduced at various times by different importers, and scattered through the Colony; the names have consequently been lost or mixed, and the utmost difficulty is now experienced in being sure what any species growing in Natal really is.

What is known as the Common Bamboo may be Bambusa vulgaris, Bambusa Balcooa, or several other species; the rather smaller one with solid stems is probably Dendrocalamus strictus; the very large thorny species is Bambusa arundinacea (B. spinosa), the small hedging species is Bambusa Fortunei (of which there is also a variegated form). B. nigra has black stems and a suckering habit; the indigenous Berg Bamboo is Arundinaria tessellata, Munro. Several unknown species, small, medium, and large, have variegated or yellow stems, and there are also several—probably many—other species here of which the names have been lost, and which are not now easily identified. All the local species are, however, useful, the larger ones in native and coolie building construction, sheds, poles, trellis, fences, fruit boxes, etc., etc.; the smaller ones as whip sticks, fishing rods, walking sticks, etc.; and the one species forms a useful and ornamental hedge. In India the young shoots of some big species are eaten, and they are also used for pulping for paper. Immersion in water for some weeks renders the cut stems more durable. Gamble states that:—"The total outturn of the Indian forests is about 140 to 150 millions (stems), of which at least 100 millions probably come from D. strictus." Splendid clumps of the large Bamboo (Fig. 84) are abundant in Natal, usually growing best in deep moist fresh valley soil, those around Maritzburg being particularly fine, though this Bamboo also does well on the Coast, and succeeds even on high, exposed, and fairly dry situations, as well as in swamps. It is a first-rate consumer of super-abundant moisture, and in dry situations requires much space, as it dries out the neighbourhood too much for any other crop, but it forms a good breakwind, and

a grand avenue or specimen plant. The cultivation of Bamboo for paper pulp may possibly come in in the swampy region of Zululand and Amatongaland.

The Bamboo propagates by division of clumps into single leads, leaving a foot of old stem attached, but such division entails enormous labour, so the propagation by cuttings laid down flat is more frequently used. Mr. H. W. James, who has long been a Bamboo grower, explains his process as follows:—"Bamboos grow most easily from cuttings. Three joints are what I use. I put in an acre last November, two cuttings in each hole, each row 35 to 40 feet apart, and the holes distant 20 feet. The cuttings are sections of a two-year-old bamboo; the sideshoots cut off at two or three inches from the stem. I have not one miss, and the shoots are now (October) from 10 to 20 feet high. The largest and longest bamboos are grown in strong, black, damp soil, and run up to 80 feet; the strongest in sandy soils, as at Pinetown, where the best whipsticks are grown in poor sandy soil. I have grown Bamboos from roots, but these did not do nearly so well as the cuttings, as above. It is not necessary to bore holes and fill with water. Care should be taken not to expose the cuttings to the sun, as an hour's exposure is generally fatal. In transplanting the cuttings I would suggest that the holes 5 feet long, 1 foot wide, and from 1 foot to 14 inches deep, be prepared, so as to plant at once on arrival, to be covered by about 5 inches of earth. Indeed, the planting is simply like sugar cane planting, only with larger holes. I may add that I seldom take more than three cuttings (i.e., 15 feet) from one bamboo, as the upper parts are too thin. I select what is not too young, nor yet ripe, but green, and such as will, I know, grow."

This method was found to be quite satisfactory at Empangeni Plantation, where several acres were planted this year, and every cutting struck, after travelling by rail from Natal.

Most other Bamboos propagate in the same way, though some sucker naturally, and others succeed better when layered, a stem partly cut through being lowered and pinned into trenches alongside the old plant until roots are formed at each joint, when it can be divided into several plants.

Bambusa arundinacea.—(B. spinosa) is hardly worth culture, for though as large and as ornamental as the other, the difficulty of extraction is enormous, the spines fixing the whole clump securely together.

Many new bamboos have recently been imported by the Forestry Department, and others will follow as opportunity offers.

Chusquea culeou.—A South American Bamboo, may be more hardy than the Indian kinds, and so also may some of the Chinese and Japanese species.

The indigenous Berg Bamboo occurs only in swampy spots, or under wet rocks high in the Drakensberg, and has not, so

far as I am aware, been successfully cultivated elsewhere. It grows nearly to whipstick size.

BAMBUSA FORTUNEI.—Figs. 53, 81, 91, grows naturally to about 10 feet in height, and forms a very ornamental dark-green clump, but when planted in hedges (by cuttings) and kept pruned it forms in the midland and lower districts one of the neatest and best hedges.

CANANGIUM ODORATUM.—Is a large Indian tree of very rapid growth, producing soft, useless timber and highly scented flowers, from which *Ilang-ilang* perfume is prepared. Fit for the coast only.

CERATONIA SILIQUA.—*Carob Trèe* Fig. 80), is a small Mediterranean tree, from the beans of which a highly nutritious cattle feed is prepared. An enormous amount of these beans is exported from Crete, where highly fertile pistillate varieties are grafted on seedlings, leaving a few male trees intermixed to fertilise them. Seedlings are sometimes male, sometimes female, and sometimes hermaphrodite, the latter carrying poor crops as compared with well-fertilised pistillate trees, which occasionally bear half a ton of beans per tree. The tree likes a fairly deep calcareous soil, especially if moist during winter, though it also lives on the shale formation and in the thorn veldt, bcoming more or less deciduous there during hard times. It is hardy enough to live anywhere in Natal, but as it flowers during winter the crop is often destroyed by frost up-country. There are many trees of it in Natal, all seedlings, and a further supply of imported seed was imported last year by Hon. Joseph Baynes, M.L.C., for free distribution by Government. Government has also been making endeavours to have some of the most fertile European varieties sent out as grafted young trees. As an ornamental tree it is well worth culture where it succeeds, but in shallow soils it becomes scraggy early. It forms a deep tap-root when quite a young seedling, so becomes difficult to transplant, and should rather be sown in situ, or sown singly in deep tins and planted out early. Several trees should be planted together to secure fertilization.

CALOPHYLLUM.—Is a genus of evergreen tropical trees, with large parallel-veined leaves, and showy flowers. The timber of several species is used in India and the East Indies for masts, shipbuilding, and other similar works.

C. INOPHYLLUM and C. CALABA are growing in the Botanic Garden, Durban. Gamble states concerning C. inophyllum (the Alexandrian Laurel), which is rather a tropical than a subtropical species:—"A beautiful tree with a round fruit, from which an oil is extracted and used for burning. The wood is said by Beddome to be valuable for some purposes in shipbuilding, and by Kurz to be good for masts, spars, railway sleepers, machinery, etc.' Mendis says it is used for the masts and spars of dhonies and fishing boats. Sebert, in 'Les bois de la Nouvelle Caledonie,' says that it is a magnifi-

cent wood for cabinet-maker's work, and that it gives a yellowish green, pleasantly scented resin. He gives the weight of about 59 lbs. per cubic foot. . . . . In the Andamans it gives squares up to 25 feet, siding 1 ft. 6 in." Other ornamental species are more hardy, and also yield good timbers, and are probably suitable for lower Zululand.

CASSIA.—Is a large genus of leguminous herbs, shrubs, and trees, several of which abound here, more or less as weeds, their free-seeding propensities rendering common what would otherwise be ornamental species. Many species yield senna.

CASSIA FISTULA.—A deciduous yellow-flowered species, is an Indian timber and avenue tree, though the timber is usually of small size. In reference to the specimens in the Durban Botanic Garden Mr. J. Medley Wood says:—"When in flower a very beautiful object, having a striking resemblance to the Laburnum. The wood is good, and in common use in India for agricultural implements, etc. The pods are long and cylindrical, divided into cells, and the seeds are surrounded by a sweet pulp, which in India is dried, and forms an article of commerce. The bark of the root is a strong aperient."

CAESALPINIA CORIARIA.—The *Divi-divi* (Fig. 47), a bushy tree from Central America, where it is said to grow in coast saltmarshes, and yield pods to the extent of 100 lbs. per tree. Mueller states that the husk of the pod, "commercially known as Divi-divi, is regarded as the most powerful and quickly acting tanning material in India. The mercantile price of the pods is from £8 to £13 per ton. England imports about 4,000 tons annually; the bark is used for tanning. Lac is also gathered from this bush."

It grows well in the Botanic Garden, Durban.

C. PULCHERRIMA.—Poincianao pulcherrima, is an ornamental tender shrub, bearing a profusion of scarlet flowers.

Several prickly species, including C. Bonducella, make rough hedges; others, as C. sappan, C. brevifolia, C. tinctoria, C. vesicaria, C. crista, and C. echinata, yield dye woods, while C. brevifolia is the *Algorobillo* of Chili, noted for the high percentage of tannic acid in its pods. Most are shrubs or climbers rather than trees, and usually showy when in flower.

CASTANOSPERMUM AUSTRALE.—*Moreton Bay Chestnut* (Fig. 422) makes a beautiful evergreen tree when at its best, but requires deep soil and moisture to make it do so. On shallow or dry soil it is hardly satisfactory. It does well around Maritzburg and throughout the Midlands, also fairly well to the Coast. Best specimen seen was at Mr. Ford's, Chase Valley, the deep green foliage showing off well the red flowers which are produced on the old stems, and followed by pods containing 2 or 3 chestnuts each; these, however, are not used. The timber is said to be of high quality, like walnut, but seldom large enough for technical use. Foliage reputed in Aus-

tralia to be poisonous to stock. A good street tree on deep soil, otherwise not reliable.

CASUARINA.—Is a genus of Pine-like trees, mostly Australian, in which the utmost confusion reigns with regard to nomenclature and synonymy. They vary much in quality of timber, and as all are readily grazed by cattle they require protection from these.

CASUARINA LEPTOCLADA.—*Beefwood* (Figs. 29, 32, 42), forms a fine tree where it does well, as is usually the case when it is planted singly in a garden, but it is more or less regularly a failure when planted closely in forest groups. It likes deep soil, and fresh moisture, but is easily drowned by stagnant water. All the Casuarinas suffer and whiten through excessive drought, but recover more or less on the return of rain. The timber is white, fairly hard, said to be useful for boards, etc,. but never as yet tried in the Colony so far as I know. The tree gets to a height of about 80 feet and diameter of 2 feet in 15 years under favourable conditions, and makes a nice shade tree, though some object to the noise made in it by the wind. Does not transplant easily after being once established in the open ground.

CASUARINA SUBEROSA takes its name from the corky bark which is developed when quite young. Its growth is very poor as compared with C. leptoclada, its general appearance similar, so except as a sub-dwarf it has no qualification.

Casuarina stricta and C. tenuissima have habits like C. leptoclada, but are less robust.

C. EQUISETIFOLIA is more tropical than the other species, and has a reddish-brown timber, useful for fuel and other domestic purposes. It has been largely used in India for the reclamation of coast sands, and is recommended by Gamble as fit for fixing sand preparatory to planting Cocoa-nuts and other trees. It is short-lived, seldom reaching heavy-timber size, and inclined to sucker, or produce decumbent rooting branches, which assists in sand-fixing.

CASUARINA TORULOSA (Fig. 48) is an ornamental small bushy tree, forming a nice avenue tree for the Coast and subtropical districts, and giving a contrast to other trees by its distinctly reddish hue. It seldom reaches timber size here, but is used for furniture, etc., in Australia.

CASUARINA QUADRIVALVIS, the *She-oak*, is like C. equisetifolia, used for drift sand reclamation, has red beautifully-grained timber, and makes a nice medium-sized tree with drooping dark green foliage.

There are several other Australian species not yet tried here, including C. Fraseriana, which Mueller states is the best furniture wood of South-Western Australia.

CECROPIA PELTATA (Fig. 42). A striking ornamental tree of grotesque habit, as grown in the Durban Botanic Garden. In the Guide to that Garden the following particulars are given concerning it:—"The Trumpet-tree of West Indies and South America, so-called because its hollow stems and

branches are used for making musical instruments. From the larger ones a kind of drum is made by the Indians. The bark yields a tough fibre, the young buds are eaten, the leaves are the common food of the sloth, and the milky juice hardens into a kind of India Rubber. The wood is light, and used for floats for fishing nets, also for obtaining fire by friction."

Cedrela is a genus of ornamental trees having foliage more or less like the Ash or the Walnut, and a red, soft, scented timber known as "Red Cedar," largely used, especially for cigar-boxes, but useful also for tea-boxes, and general purposes if obtainable.

CEDRELA ODORATA (Figs. 49, 55), which comes from Central America and West Indies, has done best in Natal, having grown in 34 years to 6 feet 8 inches girth and 66 feet height in the Durban Botanic Garden, while in Maritzburg it has also made good growth on the Town Hill, and seeds freely. Planted along with Gums in several places it has been altogether dominated. Mueller states concerning it:—"Wood light, of pleasant odour, easily worked, preferentially chosen in its native country for cigar boxes and a variety of other articles, also furniture. The tree exudes the aromatic Acajou-resin, like C. fissilis."

It is one of the best trees for commercial planting in lower Zululand.

CEDRELA TOONA, the *Toon*, is, according to Gamble, one of the most important of Indian trees, and is there very largely cultivated, showing, however, a tendency to extend itself by self-sown seedlings. "The wood is durable, and is not eaten by white ants; it is highly valued and universally used for furniture of all kinds, and is also employed for door panels and carving. From Burmah it is exported under the name of Moulmein Cedar, and as such is known in the English market." The tree grows to 20 feet girth, weighs about 30 to 35 lbs. per cubic foot, and is largely used for tea-boxes. In Natal it has not made growth equal to C. odorata, but being more tropical, it may do better in lower Zululand, while the hardier Australian form, C. australis, may replace it inland.

There are several other species from South America and India not yet tried here, but producing similar valuable timber, while some Himalayan species are evergreen and very ornamental. Apart from true Cedar timbers, the timber of Cedrela is among the most important that can be grown here, especially on the coast. As single specimens they are ornamental, though the deciduous species lose their foliage for a time, but it is rather as timber trees, planted so as to allow development and still prevent heavy branching that their value comes in.

CHLOROXYLON SWIETENIA, the *Satin-wood*, from the drier forests of Southern India and Ceylon, seems likely to succeed on the Natal Coast, though I am not aware that it has been tried. Gamble states:—"This beautiful tree gives the Satin-

wood of commerce, which is largely exported from Ceylon, and, to a much less extent, from India. It is much used for cabinet-work, and the backs of brushes, also for pretty furniture and picture frames. Locally it has been used for building, for carts, and agricultural implements. It has been tried as a substitute for boxwood for engraving, but not very successfully. Sleepers made of it have lasted for 20 years on the Ceylon Railway; and so far the experiments as to its behaviour in sea water point to its resisting teredo. A celebrated bridge at Peradeniya, near Kandy, with a single arch of 205 feet span was built entirely of it."

CHRYSOBALANUS ICACO, the *Cocoa Plum*, from the West Indies and South America, does well in the Botanic Garden, Durban, and produces in quantity its plum-like fruits about the size of large cherries. The proportion of kernel to flesh is high, but the flavour is agreeable, and if grown in quantity it would probably add another to our preserving fruits. It is not likely to displace anything as a dessert fruit. Mr. Wood says:—"The kernels yield an oil, said to be useful in dysentery, and the leaves are also used medicinally."

CHRYSOPHYLLUM CAINITO, the *Star Apple*, is an evergreen bush or small tree, bearing an edible fruit. It does well in Durban, but the fruit has not taken on.

CINCHONA is a genus of South American trees, several of which yield bark rich in alkaloids, the cultivation of which for the production of Quinine has become a very large industry in India, Java, and other countries where tropical fevers require the constant use of preventive treatment. In India much of the Quinine is grown by Government, and sold in single cheap doses at the post offices. In Natal Cinchona culture has not yet been practically taken up, and though there have been a few specimens standing for many years there is nothing yet to prove whether or not a commercial industry can be started with prospect of success. The natural home of the Cinchonas is within the mist-belts of the Andes, clear of frost, but "within sight of snow." Rich forest soil, open subsoil, and a certain amount of forest cover, seem to be the best conditions. Mueller states:—"The Cinchona-region may be regarded as inter-jacent between the coffee and the tea region, or nearly coinciding with that of the Assam tea. Cross found the temperature of some of the best natural Cinchona regions to fluctuate between 35 degs. and 60 degs. Fah." The Cinchonas grow from seed, and seed when young, and the harvest of bark begins in the fourth or fifth year. In Indian plantations the trees are set out 6 feet apart. Cinchona succirubra, which is growing in the Durban Botanic Garden, is the species most largely cultivated in India, but C. Calisaya, C. officinalis, and C. micrantha, are also in use. All grow naturally to be trees of 40 feet height or more, and probably the most suitable localities for them in Natal will be found in the mist belt, especi-

ally in the Karkloof and in Nkandhla District. In the Annual Report of the Durban Botanic Garden for 1874 it is recorded that the plant of Cinchona there had been destroyed "by irruption of cattle," that another tree supplied from there had been planted in an unfavourable position, and two others killed by frost. Such misfortune appears to have followed Cinchona here.

CINNAMOMUM CAMPHORA, the *Camphor tree* (Figs. 32, 43, 83), an ornamental evergreen tree, from China and Japan, is the source of the camphor of commerce, which is obtained by distilling or boiling the chopped wood or root. The whole tree is impregnated with the camphor, so the leaves can also be used, and the timber is practically insect proof, and cases or drawers made of it are so also. The timber is highly ornamental as a furniture wood, being yellowish, streaked with dark veins, and even here is obtainable in furniture size, while in Cape Colony there are fine old trees, especially at Somerset West. Trees scattered through Natal from the coast to the mist-belts have done well in suitable localities, and kept alive even where not suitable. It prefers to be clear of frost, but does well at Pretoria, and lives in Johannesburg. It likes deep open soil, especially forest soil, and prefers to have forest surroundings and shelter, but sufficient space to allow it to develop. It is inclined to branch too low, and therefore requires attention to keep it to a main stem, or the timber becomes too small for technical work other than distillation, which will probably not be started here until large forests are planted. It seeds freely at a comparatively early age, and goes through nursery treatment with little difficulty.

It should form an important item in coast forestry.

CINNAMOMUM CASSIA, the *Cassia bark* tree (Fig. 69), has done better in Maritzburg than Durban, the tree photographed being about 20 years old. It is a native of China, where it is chopped down when about 6 years old to near the root for the sake of its bark. Mueller states:—"The bark on distillation affords the cassia-oil, one cwt. of bark yielding nearly one pound of oil, which is much in use for confectionery and culinary purposes, and the preparation of scented soaps; it is one of the most persistent or retentive in perfumery. Oil can also be obtained from the foliage."

CINNAMOMUM ZEILANICUM, the *Cinnamon tree*, another native of China and Japan, lives in Durban, though it can hardly be called a complete success there, but probably more suitable sites may still be found for it in Natal. It is only a small tree, concerning which Mr. Wood states:—"The best bark is obtained from the middle-sized branches, an inferior sort from the younger ones, while that from the thickest ones is of very little value. The root of the tree yields camphor, and the leaves an aromatic oil, while the fruit leaves a peculiar terebintaceous volatile oil.

There are several other Indian species of Cinnamomum, some yielding useful bark or timber, but these are not grown here yet.

COCCOLOBA UVIFERA is a large ornamental tree from Central America, yielding a red dye-wood. The bark yields kino, the fruit, which is about an inch long, is edible, and the tree is fit for use on sandy sea-shores, producing stems occasionally of two feet diameter. It grows in the Durban Botanic Garden, and suits the coast.

DALBERGIA SISSOO, the *Sissoo*, is one of the most important Indian timber trees. Though seldom a large tree, it is planted throughout most parts of India, and Gamble says that:—"Except teak, sissoo has been more planted than perhaps any Indian tree, and attention need only be invited to the splendid success obtained at Changa-Manga, in the Punjab, the result of sowings in irrigated land; to the growth at Shahdera, near Lahore, where the land is liable to yearly flood by the overflow water of the Ravi, and to the canal plantations throughout Northern India." He adds:—"The wood is very durable, seasons well, and does not warp or split. It is highly esteemed for all purposes where strength and elasticity are required. Clifford says that 'in strength it is only inferior to Sal, while in many other useful qualities it surpasses it, and has the advantage of being lighter. For felloes and naves of wheels, and carved work of every description, for framings of carriages, and similar work, it is unsurpassed by any other wood, owing to its fine seasoning and standing qualities.' It is extensively used for boat-building, carts, and carriages, agricultural implements, in construction, and especially for furniture. As a furniture wood and for carving it is probably the finest wood in India, and it is in regular demand for these purposes all over the north." It grows from pods sown in situ, but does not easily transplant; it coppices and grows from suckers, and it prefers a deep sandy soil along a river bed, but dislikes stagnant moisture. Probably its requirements can be met in lower Zululand; thus far its growth in Durban has not been promising. It is deciduous, and of light foliage. Several other Indian species of Dalbergia yield good furniture timbers, while two Brazil species, D. miscolobium and D. nigra, yield part of the Jacaranda wood, or Palisander wood, exported to Europe as furniture timber. Any of these may prove fit for use here, but require trial.

DYSOXYLON FRASERIANUM, the *Pencil Cedar* of Queensland, is a large valuable timber tree, which may be worth trial in Zululand. D. Lesserti and D. Muelleri yield similar Cedar timbers.

ERYTHROXYLON COCA is the shrub from the leaves of which cocaine is obtained, a strong stimulating drug and local anaesthetic now in considerable demand. The leaves themselves are used to an enormous extent in South America.

The shrub does well in Durban, and may be expected to do so where frost is absent; it can be propagated by seed or by cuttings. In the Report of the Natal Botanic Gardens, Durban, for 1901 Mr. J. Medley Wood says:—"I note in the 'Pharmaceutical Journal' of June 3rd that 74 bales of the dried leaves of this plant were bought in nominally at 1s. 4d. per lb. It is worth noting that this shrub not only grows well in the coast districts of Natal, but also that a small parcel of the dried leaves which I sent Home in 1885 were thus reported on (see my Annual Report for that year): 'Leaves picked from our plant in July were sent to Messrs. Christy and Co., of London, and have been tested by Mr. Dillworth Howard, and found to contain 0.29 per cent. of alkaloid, and Mr. Howard remarks "they are a very nice sample, and test well." There is not a very large demand for this drug, but as the plant from which the leaves were taken was only put out in 1883, it is evident that it is a plant that soon yields a crop, and as no machinery is required in the preparation of the leaves for market it might be worth a trial by small farmers on the coast, and at anything like the price quoted should pay well.'"

EUGENIA is a large genus containing evergreer trees, shrubs, and dwarf shrubs, many of which have more or less edible fruits, most have ornamental foliage, several have useful timbers, and some have a high percentage of tannin in the bark. Several exotic species are in cultivation here, and the "*um-doni*" is one of our best known indigenous trees.

EUGENIA EUCALYPTOIDES is an ornamental small tree fit for lawn decoration, which has done well in Maritzburg.

EUGENIA BRASILIENSIS, the *Brazil Cherry*, yields a pretty fruit used for making jellies, etc.; it is not uncommon throughout the coast districts, and makes a very neat hedge when well dressed.

EUGENIA JAMBOS, the *Rose Apple*, bears a pretty scented but rather insipid fruit, which is used to flavour preserves of other kinds.

EUGENIA JAMBOLANA, the Jaman, is an Indian tree which grows well up to Maritzburg, and yields an astringent fruit used in India in cookery and preserves. The timber is used in India for many domestic purposes, and is said to be white ant proof. The seed soon loses vitality, and the seedling tree does not transplant well.

EXCAECARIA AGALLOCHA, an evergreen tree of medium size, from the coast and tidal forests of India, where its timber is considered useful for many domestic purposes. The juice of the bark is acrid and poisonous. It succeeds in the Botanic Garden, Durban.

EXCAECARIA SEBIFERA, is the Chinese *Tallow-tree*, a rather slow-growing small tree which has, however, done well in the Botanic Gardens of Durban and Maritzburg. Mr. Medley Wood states:—"The coating of the seeds contains a fat which

is separated by boiling. The wood is hard, and has been used for printing blocks, and the leaves yield a black dye."

FICUS (see Chapters 9 and 10).

FLINDERSIA, several species, large Australian hardwood timber trees, valued for their timber as well as for their suitability for avenue purposes, have not been tried here so far as I know. F. australis is the Queensland *Crows Ash;* F. bennettiana, the *New South Wales Teak;* and F. oxleyana, the Queensland *Yellowwood;* the latter yields a dye as well as timber. The mist belt will probably suit them.

GARCINIA is a genus of everygreen trees or shrubs, mostly tropical, belonging to Asia and Australia, with one representative in the Natal Forests. From several Indian species gamboge is collected as an exudation from the bark, but evidently it would not pay at Natal rates of labour, even if the trees would thrive.

Several yield more or less acid fruits used as a substitute for limes, or in curries, or medicine; G. mangostana is the Mangosteen, a highly relished tropical fruit; several others have edible fruits; and from the seeds of several species oil is obtained used for various purposes. The timber is occasionally used in several species. Fig. 53 shows G. cochin-chinensis as grown in the Botanic Garden, Durban, where its fruit is edible, but not palatable when ripe.

GREVILLEA ROBUSTA, the *Silk Oak* (Figs. 33, 90), has been largely planted throughout Natal as an ornamental and avenue tree, the fern-like leaves, the profusion of golden-yellow flowers in spring, and the general habit rendering it a favourite with all. The timber shows the characteristic marking of the Proteaceæ, and makes beautiful furniture, but has not been otherwise used here as yet. Gamble says:—"The wood is handsome, and if judiciously cut to show the silver-grain to the best advantage, would do well for pannelling, parquet floors, and furniture, but it requires careful seasoning." Wood calls the timber "elastic and durable." In Natal it does best in the deep soil of cool, moist forest-valleys, rising rapidly to 60 feet height and two feet diameter; it makes healthy growth, however, all along the coast and Yellowwood belt, and even in drier upland localities like Ladysmith, Dundee, and Newcastle it still makes fair growth. Largely used for a shelter and shade tree near the coast where few other trees do well. Easily raised from seed, seeds freely, and is a most ornamental tree in its sapling stage.

Several other species are in cultivation as flowering shrubs or trees, especially G. Caleyii (Fig. 42) and G. Fosteri (scarlet flowered), and G. Hilleana (Fig. 42) (whitish yellow).

GUAJACUM OFFICINALE, *Lignum Vitae.* A slow-growing West Indian tree, yielding a hard, heavy, greenish timber, in demand for bearings and similar purposes. The tree is ornamental, especially when set with its pretty flowers, and is already in the Durban Botanic Garden.

HAEMATOXYLON CAMPECHIANUM, *Logwood*, from South America, is rather a small tree, yielding *logwood* used for dyes and ink, and as a chemical reagent. It is represented in the Durban Botanic Garden.

HANCORNIA SPECIOSA is a small rubber tree widely distributed in South America, which has not been tried here yet. Mueller, who recommends it for sandy plains, says:—"The good-sized berries are of very pleasant taste, and vernacularly known as Mangaihas. Most valuable is the very elastic rubber of this plant. Mr. Thomas Christie regards it as superior to Para-rubber, and worth at present 3s. per lb."

HYMENAEA COURBARIL, *Courbaril Algaroba*, a very large American timber tree, has made slow growth in the Botanic Garden, Durban, having made 3 feet 6 inches diameter and 66 feet height in 36 years. It may do better in the mist-belt. The timber is a strong, heavy, elastic hardwood, used for machinery, beams, etc. West Indian Copal is a resin exuded by the stem; and the pulp of the beans is used as food.

JACARANDA MIMOSAEFOLIA (Fig. 52) is often grown on account of its very ornamental fern-like deciduous foliage, and also its profusion of pale-blue flowers, which appear while the leaves are off. It succeeds on deep rich soil wherever frost is almost or entirely absent, usually making rather a low flat-topped tree. One in the Botanic Garden, Durban, has made 5 feet 6 inches girth and 40 feet height in 18 years. "The timber is bluish-red; traversed by blackish streaks," and "furnishes a beautiful and fragrant kind of Palixander-wood" in its native country, Brazil. It is well worth garden cultivation, and is now being planted more largely in the Empangeni Plantation.

LAGUNARIA PATERSONII (Hibiscus Patersonii) (Fig. 82), is a very ornamental evergreen tree from Norfolk Island and Queensland, assuming naturally a pyramidal form, and is very profuse in the production of its large pink hibiscus flowers. It thrives and grows quickly throughout Kaffraria and Natal, the trees in the Maritzburg Botanic Garden being in the best of health, though surrounded by white ants.

LEUCADENDRON ARGENTEUM, the *Silver Tree* of Table Mountain, Cape Town, gives a colour in mixed landscape planting which is not easily obtained by any other tree. Unfortunately the climatic conditions here differ widely from those of the Cape, and the Silver-tree does not take well to Natal, only a few trees beng alive up to an age of ten or twelve years. It is, however, worth garden culture even for that time. On the Drakensberg somewhat the same effect is produced by various indigenous Proteaceae.

LITSAEA SEBIFERA (L. chinensis), from India and Ceylon, forms a fine evergreen dioecious tree in the Botanic Garden Durban. Gamble states concerning its occurrence in India:—"A fine tree of very variable appearance, and nowhere very common; consequently the wood, though good, is not much

in demand. Growth moderate, 6-7 rings per inch of radius. Weight 47 lbs. per cubic foot. The bark is used medicinally for external application, bruised and mixed with goat's milk, for sprains and bruises." In the Report of the Natal Botanic Gardens, 1902-3, the medicinal uses are explained, and it is also stated:—"The oil from berries of L. chinensis is employed in India as an ointment for rheumatism, while in China and Java candles are made from it."

LOXOPTERYGIUM LORENTZII, from Argentine, supplies part of the *Quebracho Colorado* tanning material shipped to Europe. Mueller states:—"The bark and wood, called Quebracho colorado, extensively used for tanning; latterly much exported to Europe. The length of time for the tanning process with this bark is only half that for oak bark. The kino of this tree has come into therapeutic use." Hutchins, advising the Transvaal, says:—"Very valuable but slow growing. Its timber is indestructible and full of tannin. The wood and tan extract made from it is largely exported from the Argentine. A first-rate timber for sleepers, but only well suited to Barberton and the lower districts."

I am not aware that it has been tried in Natal. For further information concerning Quebracho see under *Aspidosperma.*

LOXOSTYLIS ALATA.—A small ornamental tree, resembling Pepper-tree (Schinus molle), from the neighbourhood of Grahamstown.

MACHAERIUM, several species, from Brazil, yield durable timber, and may be worth trial.

MAGNOLIA GRANDIFLORA (Fig. 82), with its glossy dark-green leaves and enormous white highly-scented flowers, is one of the brightest ornaments of Natal gardens, especially in the coast-ward and mist-belt regions. For a North-East American tree it succeeds wonderfully, and is worth a place in every suitable garden, but for timber it does not seem to be likely to be of the use it is on the Mississippi.

Several other evergreen, as well as deciduous species, are well worth cultivation for ornament, the flowers ranging from white to purple, and several are of use for timber purposes in their natural homes, especially M. hypoleuca, of Japan, and M. Campbellii, of Sikkim; the latter has been rendered scarce there by being used for the manufacture of tea-boxes.

MANGIFERA INDICA, the *Mango* (Figs. 76, 81), is much grown as a seedling fruit tree along the Natal coast, where it forms a low spreading bushy tree, with heavy evergreen foliage, and where it fruits freely, though the fruit is said to be not equal to those grown in India or Mauritius. Several improved varieties exist here, propagated also by seedlings, the practices of budding, grafting, and inaching not yet having had much local application, though constantly practised in India. In India and Jamaica the tree has run wild in places, and the timber from such trees is found to be of economic

value. Gamble states:—"The wood is used for planking, doors, and window frames, in Calcutta for packing cases, and in Behar for opium—and indigo boxes; canoes and masula boats are made of it. In Dehra Dun, and some other tea districts, it is in large demand and universal employ for tea-boxes. Weight, 42 lbs. per foot." In Natal it grows in selected sites as far inland as Maritzburg, and is said to produce the finest fruits in hot, dry localities and in hot, dry years. Grafting of selected varieties must come in in nursery practice.

MELALEUCA is a genus of bushy trees, some of which finally grow into tall and useful timber trees, and several inhabit tidal shores and brackish muddy lagoons, growing where no Eucalyptus can live. For use on the malarial swampy flats of Zululand these may be a decided acquisition, even though slow-growing as timber trees, and as hedges they can be utilised where other kinds fail. Most of the species also grow, though slowly, on any deep alluvial soil, from the coast to the mist-belts, and are distinct and ornamental in their habit.

M. LEUCADENDRON, M. squarrosa, and several other species produce a papery bark, which is in commerce as a material for fruit packing; M. leucadendron also produces useful heavy ant-proof and imperishable timber, while its foliage yields Cajaput oil.

MICHELIA species are large Indian trees, allied to Magnolia, some evergreen, others deciduous, and some with conspicuous scented flowers. M. champaka, which is growing in the Durban Botanic Garden, is a fine evergreen tree, much cultivated in India, producing scented flowers and strong durable timber weighing about 37 lbs. per cubic foot.

MIMOSA RUBICAULIS (Fig. 55) is a low flat-headed tree, having the general habit of Poinciana regia, and a distinct and ornamental appearance, but it is not a timber tree even in its Indian home.

MIMUSOPS includes even among Natal trees several fine species, including the Red Milkwood; in India and Ceylon there are several others regarded as among the chief timber trees of the dry evergreen forests, the timbers being strong, durable, and heavy, used for wagon-work, cabinet-making, and house-building.

M. ELENGI is already growing in the Durban Botanic Garden.

M. HEXANDRA may also be worth introduction, and M. littoralis takes the place in India that M. caffra does here on the sea-dunes, but gives larger scantlings, and is white ant proof as timber.

MYRISTICA is a distinctly tropical genus, inhabiting India and the East Indies, and yielding the nutmegs of commerce. They have most ornamental foliage, but supply very little of the timber products even of their natural habitats. Here the prospect of successful growth is not high, though two species,

M. fragrans and M. surinamensis, are represented in the Durban Botanic Garden.

MYOPORUM INSULARE is a low spreading tree, with an umbrella habit and thick corky bark, which produces close-grained useful timber for cabinet-work. It makes a nice, small specimen or shade tree, strikes from cuttings, and does well in Kaffraria when kept clear of scale. It is a coast tree, and grows along sea marshes, as also does the New Zealand M. laetum.

NEPHELIUM LITCHI, the *Litchi* (Fig. 81), is a Chinese tree largely cultivated in India for its delicious fruit, of which many varieties are now in use there. In Durban the trees have grown well, but do not fruit early, and even after they begin are rather irregular in their fruiting. The tree is, however, now being propagated by aerial layers, which should fruit while young. The tree likes to have an abundant supply of fresh water available. Several other species of Nephelium are cultivated, N. lappaceum for its fruit, the *Rambutan*, N. Longanum, also for its fruit, the *Longan*, which in Durban is barely edible, and others for their beauty and shade. The timber is not important in either.

OWENIA ACIDULA, the *Rancouran*, is a small Australian timber and fruit tree, which has made fair growth in the Durban Botanic Garden, but the fruit is not very palatable. O. venosa is another Queensland species, known there as Sour Plum.

PAULOWNIA IMPERIALIS is a small Japanese ornamental tree, producing a fine foliage effect, and well worth garden cultivation wherever frost is absent, or nearly so. It does fairly well both in Durban and Maritzburg. Its habit is like Catalpa, but more satisfactory.

PERSEA TENERIFFAE is a fine tree from the Canary Islands which may be worth introduction as a timber tree, as it produces "a beautiful, hard, mahogany-like wood, especially sought for superior furniture and turner's work."

P. GRATISSIMA is the well known Avocado Pear, which grows from the Coast to Maritzburg; P. carolinensis is a North American timber tree already on trial here, and P. Nan-muh is a Chinese tree yielding a valuable soft, scented, brown timber.

PHOTINIA ERIOBOTRYA (Eriobotrya japonica), the *Loquat* (Fig. 36), is one of the finest foliage and shade trees we have, where it does well. Its use in that respect is more important than its use for fruit or for timber, though it has a value for each, and some selected fruit varieties are now being perpetuated by grafting and budding. The tree does best on deep open soil, not necessarily rich, and where the climate is cool and moist rather than excessively hot. A tree at Hilton College, about 40 years old, and another at Esmont, Mid-Illovo, not quite so old, are grand picnic trees.

PHYLLANTHUS EMBLICA, a deciduous Indian tree, which according to Gamble, is there "a pretty and ornamental tree, but of not much importance, though giving a good fuel and useful in coppice forests, as it reproduces freely from the root. The wood makes good poles, and is useful for agricultural implements, building, and furniture; it is durable under water, and can be used for well-work. The bark and leaves are used for tanning, and in medicine; chips of the wood are said to clear muddy water. The fruit is the *Emblic Myrobolan*, and is used as a medicine, for dyeing, tanning, and for food and preserves." In the Botanic Garden, Durban, there is a tree 40 feet high and 4 feet 6 inches girth.

PHYTOLACCA DIOICA, the *Belhambra*, is a soft umbrageous tree, growing very rapidly to a large stem, and a more or less spreading canopy. Its fault is the extraordinary development of the larger roots, which lift the soil, and therefore render the tree unsuitable for street use. The timber is absolutely useless.

POINCIANA REGIA, *Flamboyant* (Figs. 52, 55, 90), is a handsome, flat-topped tree of very rapid growth, and making an immense display of scarlet flowers during early summer. It is a native of Madagascar, but planted in gardens and avenues in moist localities throughout the tropics. In Natal it thrives only near the coast; in Zululand it goes further inland; wherever it does well it is one of the most gorgeous trees obtainable. The timber weighs only 28 lbs. per cubic foot, and is of no technical value.

P. AUREA is a free flowering shrub of bright colour, and very ornamental, fit for garden cultivation on the coast only.

PROSOPIS is a genus of slow-growing thorny deciduous trees, taking the place more or less in India and South America that the Mimosa thorn does in Natal, and of somewhat similar appearance to that tree. The beans of most species are edible, or fit for stock feeding, having a flavour like the Carob bean, and they have been acclimatised in several countries on that account. The timber is durable, but small and slow growing, and used mostly for fuel.

P. SPICIGERA is the Indian *Jhand*, P. dulcis, P. pubescens, and P. juliflora, are the Mexican and South American *Mesquit Bean*, P. alba and P. horrida are the South American *Algaroba*, all beans used more or less for cattle feeding.

P. HORRIDA has become a weed, and taken possession in Hawaii.

PSIDIUM, a South American genus, contains many species more or less edible, of which the best known here is the *Yellow Guava*, P. Guayava, which grows slowly into a tree, producing fruit in several varieties fit for table use, jellies, and preserves. "The bark is used in medicine as an astringent, and (or the leaves) for dyeing in Assam. Skinner says

that the wood works well and smoothly, that it is used for wood-engraving, and for spear-handles and instruments" (Gamble). Many of the other species are not here yet, but one known as the *Mountain Guava* (Fig 81) makes a small evergreen tree, and fruits freely. The guavas do best in the warmer and moister parts of Natal, and are subject to maggot.

QUERCUS SUBER, the *Cork Oak* (Fig. 38), has made very satisfactory growth in Maritzburg Botanic Garden, as well as in other gardens throughout the mist-belt. It is an interesting curio, as well as an ornamental evergreen shade tree, but concerning the probability of its success for producing a cork industry Hutchins says:—"The French Forest Department hold such large stores of Cork Oak in Algeria that there is no prospect of remunerative planting for cork." The import of corks into Natal is, however, considerable.

QUERCUS ILEX, the *Holm Oak*, is not well represented in Natal, but there are several good specimens in Eastern Cape Colony, particularly at Cradock, where, under irrigation, it makes a beautiful umbrageous evergreen tree. In India and South Europe it occurs in comparatively dry districts, and yields a good tan-bark. The wood is also used, but it has little prospect as a timber tree here.

QUERCUS INCANA, the *Ban Oak*, of the drier Himalayas, is an evergreen tree with grey foliage, the timber of which is used in India mostly for fuel. A tree in the Durban Botanic Garden is 50 feet in height and 3 feet 6 inches girth.

QUERCUS ÆGILOPS, the *Valonia Oak*, produces the well-known Valonia acorns and cups imported to the extent of 30,000 tons per annum into the United Kingdom from South-east Europe. In South Africa its growth has been very miserable, and such as to discourage all further endeavour to grow it either for ornament or use.

QUERCUS ALBA, the White Oak, is one of the finest trees of North-east America, but in Cape Colony and Transvaal it has done poorly, and I am not aware that it has been tried in Natal.

Many other Oaks are of value in other countries, but there is nothing to lead one to expect that they will be commercially profitable to grow here. For ornament they require further trial.

RHUS contains many species of trees, shrubs, and under-shrubs, usually more or less pervaded with tannin. Several form large timber trees, including some indigenous species, others yield dyes, others yield wax from the berries, and some have an irritant effect on some persons. None have as yet come into commercial use here, but the import of *Sumach*, Rhus coriaria, into Britain, mostly from South-western Europe was in 1889 12,514 tons, valued at £140,517, the commercial product which is used in the preparation of Morocco leather, being the foliage dried and reduced to

powder. Many American Sumachs are also used for tanning.

R. VERNICIFERA (Fig. 43) seems healthy as a small tree in the Maritzburg Botanic Garden. In Japan and Eastern Asia it yields Japan-varnish. The crushed berries, steamed and pressed, furnish wax.

SANTALUM ALBUM is one of many species of Santalum and Fusanus which in India yield the scented timber of small size but high value known as Sandal-wood, used in fancy carpentry, and from which Santal-oil is obtained by distillation. It is a small tree, growing in more or less open county, as the Mimosa thorn does in Natal, and said to be most highly scented under the most dry and rocky conditions. Formerly much planted there, but with poor success, now rather sown direct in sparse forest, and in the working plans in Madras it is arranged that all material over 32 inches girth be removed. A tree in the Botanic Garden, Durban, is 4 feet in girth and 35 feet height.

SAPINDUS takes its name from the aril of the fruit which is used as soap in various countries. For this purpose it may not be worth culture here, but one ornamental tree is grown in the Botanic Garden, Maritzburg, under the name of S. longifolius, and S. emarginatus is grown in the Durban Botanic Garden.

Schinus molle, the *Pepper-tree*, is named on account of the smell pervading the whole plant, but has nothing to do with the production of pepper of commerce. It is a small ornamental tree, with drooping foliage and long panicles of red berries; it stands well in the drier inland districts of Natal, as well as other South African Colonies, but suffers from very severe frost, and requires some root-moisture, though it suffers from mildew during summer where the atmosphere is very damp. It has the reputation of being white ant proof as a living tree, and is consequently used in the hot inland valleys where other kinds fail. The timber has no value. There are several other species of Schinus not grown here as yet.

SHOREA ROBUSTA, *Sal*, is an important Indian timber tree, largely used there for sleepers and building construction. It has not been tried here, but may eventually be found worth a place in Natal forestry, for situations along the mist-belt, especially in Zululand.

STERCULIA ACERIFOLIA (Brachychiton acerifolius), the *Flame-tree*, rapidly makes an ornamental evergreen shade tree, which when in flower is draped in crimson, and makes a gorgeous display. It does fairly well throughout Kaffraria and Natal, but is apt to partly lose its foliage during drought.

STERCULIA DIVERSIFOLIA (Brachychiton populneus), *Curra-jong* (Fig. 39), is an ornamental evergreen tree, rapidly forming a very large bole, though the timber is not valued. In Australia it is used for keeping cattle alive during times of

drought, and the tough bast is used for native cordage. Here its value is as an ornamental tree; it does very well in Maritzburg and along the mist-belt. S. rupestris has the same habit.

STERCULIA ALATA (Fig. 46) is a tall handsome Indian evergreen tree, represented in the Botanic Garden, Durban. In the Guide to the Garden Mr. Wood says:—"A large tree, growing in deep ravines and sheltered places in India, its only use being as a support for Pepper Vines, though the seeds are sometimes eaten by the natives." Gamble calls it "an excellent avenue tree, with large cordate leaves."

SPATHODEA SPECIOSA (S. campanulata) (Figs. 45, 93). A large ornamental tree of rapid growth, producing large red trumpet-shaped flowers in great profusion. One of the most showy trees in Durban, where it does well, and also along the coast district.. It is not hardy enough for inland situations, and its timber has no value.

SPATHODEA (Dolichandrone) RHEEDII, a deciduous tree, also grows in the Durban Botanic Garden, its flowers being white, borne in profusion on the stem and branches.

SYNCARPIA LAURIFOLIA, *Turpentine tree*, is a large evergreen Australian tree, resembling an Eucalypt. It makes splendid growth in Maritzburg and throughout the mist-belts, and should form a valuable item in Natal forestry. Mueller states:—"Attains a height of 200 feet, with a stem to 30 feet in girth; rather of quick growth; well adapted to shade roadsides. The wood is very durable, mostly used for flooring and cabinet-making, as it takes a high polish; extremely durable, of excellent qualities. One of the most valuable known timbers for piles in salt or fresh water, used also for railway-sleepers, ship-building, and other purposes requiring a strong durable wood. Wood almost fire-proof."

SWIETENIA MAHOGANI, the *Mahogany tree*, of the West Indies and Central America, produces the Mahogany timber which is perhaps the most largely used foreign furniture timber in Europe. It has been largely planted in the warmer parts of India, where trees four feet in diameter have been grown in about 70 years. Gamble says:—"The result of these few data seem to show that the growth near the sea in a moist equable climate is *very* quick, and that as one goes inland, and the climate gets drier, the growth gets less, though at such a distance as Saharanpur, 1,000 miles from the sea, with a frosty winter season, the growth is still fast, averaging five rings per inch. This all seems to point to the advisability of its artificial cultivation being more largely extended, especially near the sea and on good soil. On poor soil it will not thrive, as is natural, considering that its home is in the dense forests of the West Indies, where the soil has probably many feet of humus and rich mould."

A tree in the Durban Botanic Garden measured 25 feet height and 23 inches girth after 17 years' growth. It is worth further trial, especially in Zululand.

S. MACROPHYLLA is a more hardy species, with somewhat similar timber, now being cultivated in India, and probably more suitable for Natal than S. mahogani.

The term Mahogany is applied to various other trees in other parts of the world, with nothing to connect them with true Mahogany.

TAMARIX GALLICA somewhat resembles a drooping Casuarina, except when draped in its small pink blooms. The various species of Tamarix are ornamental, but have little else to recommend them except that they thrive in the Karroo and dry districts wherever they can find underground moisture, even though brack. They grow from cuttings of wood half-inch or more in diameter.

TAMARINDUS INDICA, the *Tamarind*, forms a very large spreading evergreen tree in India, where it is extensively cultivated as an avenue and fruit tree. The timber is excessively hard, but is used in turning and for bearings, blocks, furniture, etc., and the pods are used in medicine, and as preserves. A few trees are scattered through lower Natal, one in the Durban Botanic Garden being 57 feet high and 4 feet girth.

TECTONA GRANDIS, *Teak* Fig. 49), is a large deciduous tree, widely dispersed over India, Burma, and the East Indies. Its culture in Durban and on the Natal Coast is hardly satisfactory, still further trial may give better results. It is a large-leaved tree, requiring abundant light, but all the Natal trees branch too low. Gamble says:—"The most important requirement is good drainage if good straight timber is to be obtained; but it is really a very accommodating tree, and will even stand a certain amount of water-logging, but is then usually stunted and twisted." On account of its large tap-root it does not transplant well except when quite young. The growth even in Indian plantations is excessively slow, so it will most probably pay better in Natal to grow other kinds, even though the value of the timber be less; still, in the open districts of lower Zululand teak may eventually be found an important timber tree grown in pure plantations. The term *Teak* is applied to various other trees in other countries, without any botanical relationship or even close resemblance in the timber.

TECTONA HAMILTONIANA, which is also growing in Durban Botanic Garden, is said to be less hardy, being the more tropical species.

TERMINALIA CHEBULA, *Myrobolan-tree*, a large deciduous tree, yields the Myrobolans, which are exported from India to the extent of 40,000 tons per annum for tanning purposes. These are the unripe fruits of this and other species of Terminalia, but the bark also is used for tanning and dyeing.

The timber also is used, in this and other species, after immersion, for house-building and other similar purposes.

T. BELERICA (Fig. 54) is another deciduous Indian tree, producing Myrobolans, but the value is said to be less than that of T. chebula. It is growing in the Botanic Garden, Durban, as also is T. Arjuna and T. Catappa (Fig. 45), large deciduous Indian shade and timber trees, the latter of which yields an edible nut known as the "Indian Almond." A tree of this in the Durban Garden is 4 feet in girth, 40 feet in height, and 20 years old.

T. TOMENTOSA is also a large tree, but extensively grown in India as a pollarded or coppiced tree for feeding a silkworm. The bark is used for tanning and dyeing, and concerning its use in India for timber Gamble states:—"Perhaps the most widely distributed of all the important Indian forest trees, and the one in the most universal employ for building native houses and other country purposes."

TRISTANIA CONFERTA is a large evergreen tree, resembling an Eucalypt, but more ornamental, and hardly so fast growing as most Eucalypts. It does very well in Maritzburg on deep soil, and also along the Coast, a tree in the Durban Botanic Garden being 50 feet high and 40 inches girth in 20 years. Mueller states:—"It is not only eligible as an avenue tree, but also as producing select timber; ribs of vessels from this tree have lasted unimpaired thirty years and more."

VIRGILIA CAPENSIS is a small evergreen tree, producing a profusion of sweetly-scented pinkish flowers, and well worth a place for ornament in any garden. It comes from the Cape.

ZIZYPHUS, several species, produce edible fruits, the best known of which is the jujube, Z. jujuba; Fig. 50 represents the indigenous Z. mucronata.

CHAPTER XX.

INDIGENOUS TREES.

It is often asked why the useful indigenous trees are ignored in plantation work, while exotics receive every attention. The answer is, that indigenous trees do not lend themselves so readily to cultural methods as exotics, and that in commercial tree planting they cannot compete with prospect of financial success. This seems a paradox, since these have already proved their ability to live under local conditions, while the exotics are only on trial. But the difficulty with regard to native trees is that they are the remnants of a receding flora, formerly more widely distributed under more favourable climatic conditions, and now practically confined in nature to certain zones and aspects. still receiving more favourable conditions than the country as a whole, whereas exotics are selected, so far as can be, from localities having now somewhat similar, but more severe, climatic conditions, so that when introduced here they are more able to endure general treatment on all aspects than the native trees are. Of course, there are also, in addition to these, exotics of value, but of less hardiness, introduced with the intention of taking even better value out of the best sites.

The indigenous trees, as a retrograde group, show a certain absence of vigour, which prevents them extending the margins of the forests outward, or forming fresh forest development on grass lands elsewhere; indeed, the primeter of the natural forests is almost everywhere being, year by year, reduced by the incursion of grass-fires; and that same absence of vigour is experienced when endeavours are made, by artificial plantations, to increase the area under indigenous kinds. They do not readily respond to culture, except under conditions natural to them; those of value grow slowly, even under favourable conditions; and the prospect held out by considerable experience is not such as to lead either individuals or Governments to plant these kinds largely, with a view to financial return. This does not, however, prevent some indigenous kinds being of considerable value for shelter and shade purposes, and as ornamental specimens, especially where they can be preserved from the original bush, as the inevitable clearing of private land goes on. Such specimens, already possessed of age and size, cannot be produced by culture in less than a century, and are, therefore, well worth preserving; even with a century's waiting there is seldom the same form of tree produced under culture as results

from crowded forest growth, and though each has beauty of its own, the isolated forest tree is the more majestic, and usually possesses the better bole and the fewer low branches.

Most indigenous kinds are more or less shade-bearers; that is, they endure, while young, to be grown under the shade of other trees, and only push their heads through the mass of forest cover after a considerable age has been reached. Not only do they endure this, but they like it, hence part of the difficulty experienced with indigenous kinds when planted in the open, without overhanging cover, and which make slow growth on account of being bereft of shade, humus, and forest-moisture.

Most indigenous kinds also enjoy growing on rising ground, whereby they are lifted above the frost-level, and placed more or less within the local mist-belt, or zone of occasional moist cloud; when planted on the level ground, either above or below this, they are apt to suffer from either frost, exposure, or drought. Consequently if subjected to ordinary plantation conditions, they are always less likely to do well than if grown under natural regeneration in the forest, though in the latter condition they can often be helped a great deal by the timely and judicious removal or repression of forest weeds, or of the less valuable kinds.

The extension of the indigenous forests by protection is the simplest method of afforestation; its practice involves protection against trespass, grazing, weeds, and fire, and if these are efficiently done there are few places where forest has formerly been, or where forstal conditions exist, in which natural forest will not in time assert itself. Protection against trespass and grazing is comparatively easy by means of efficient fences, without which no forestry can be very satisfactory, but protection against weeds and fire is more difficult, involving not only efficient fences, but also clean ground. The simplest method is to make a complete belt of Black Wattle, 20 to 100 yards wide, along the whole boundary of the ground to be treated; keep this belt clean by hoe or plough until the trees are far enough on to keep down the weeds themselves; the enclosed area is thereby isolated, and saved from fire from outside, and if trespass is prevented there is little prospect of fire arising inside. It may take several years for trees to get above the grass, this depending on the former condition with regard to trees, but in most suitable localities the trees sooner or later get above the weeds, and eventually kill them down. On the coast, and coast-ward districts, such recovery is usually rapid, though of poor kinds; in the midlands and on the mountains it is often slower, through the luxuriance of the grass herbage, and the slower growth of the trees, but the kinds are of greater value. Recovery of forest in this way is naturally slow as compared with plantation work in exotic kinds, and for commercial returns, as well as for domestic purposes, or ornamentation, the latter is usually preferable, though it cannot be done without considerable expense.

A few species are particular as to what kind of soil each requires; some also are confined more or less to the coast, while others prefer the mountains, but, generally speaking, any species may be cultivated in the same district, and in similar localities to that in which it grows naturally, while the total absence of any species from a district may be taken as an indication that conditions are not suitable for it. Except, then, it is proposed to give exceptional treatment or conditions to such trees, best results cannot be expected from them. Many, however, of the indigenous trees are well worth cultivation where they thrive, either as single trees or in clumps, or masses, mostly for ornamental effect.

The Reserved Trees under Proclamation 58, 1903, are:—

1. ALBIZZIA FASTIGIATA, OLIV.—*Flat Crown, Umhlandoti.* A small deciduous tree, usually found within 20 miles of the sea, though extending further inland in Zululand. Bole 1 to 2 feet in diameter, 20 to 30 feet high, with a flat spreading crown. Much in demand for naves of wheels, for which purpose the sapwood has to be removed. A small bole is consequently useless, and as many trees are damaged the supply of naves is often less than the demand. Grows easily from seed, and is being planted in Empangeni plantation, as it is thought to be a tree of rapid growth.

2. APODYTES DIMIDIATA, E. MEY.—*White Pear, Umdakana.* A small tree on the coast, often a large tree in the mountain forests. Timber close-grained, hard, heavy; used mostly for felloes, and always in demand, as the supply from the easily accessible forests is practically exhausted. Not difficult to raise from seed, and grows fairly well in the open, preferring in nature ridges where trees are few.

3. BRIDELIA MICRANTHA, PLANCH.—*Umhlahlomakwabe.* A small tree, common on the coast, used locally for many purposes, but not on the market.

4. CALODENDRON CAPENSE, THUNB.—*Wild Chestnut, Umbaba.* Frequent on the coast, where it is hardly deciduous, but much finer, though distinctly deciduous in the forests of the mist-belts. There it forms a very large tree, with a much-buttressed bole, and in early summer its masses of lilac flowers attract attention from a distance. Timber used for yokes, planking, etc. Seeds yield a commercial oil further north. Cultivates easily, but grows slowly, commencing to flower when about twelve years old. It is well worth a place in the garden as a flowering tree, but is somewhat subject to scale, especially if moisture supply is irregular. The same caterpillar which attacks Orange leaves (Papilio demoleus) often defoliates this tree.

5. CELASTRUS PEDUNCULARIS, SOND.—*Blackwood, Umnqai.* A fairly large tree, frequent in bush country throughout the Colony, under many forms. Not to be confused with the exotic Blackwood, Acacia melanoxylon. Occasionally used

for spokes; best known as producing the Umnqai Kafir kerries.

6. CELTIS RHAMNIFOLIA, PRESL.—*Camdeboo Stinkwood, Umvumvu.* A large deciduous tree, both on the coast and in the mountain forests. Timber stringy, elastic, light, used instead of Ash, especially for wagon tent-bows. Cultivates easily from seed.

7. CHRYSOPHYLLUM NATALENSE, SOND.—*Tungwane.* A large tree, frequent in the coastward forests, bearing abundantly an edible fruit. used for making into jam, but also reputed to be a native food of the fruit fly. Timber hard, used for disselbooms, etc.

8. COLA NATALENSIS, OLIV.—*Umtenenenda.* A large tree, confined to the coastward forests. Timber only used locally. Fruit, which is freely produced, may have a value similar to the West African Cola nut, though this is not yet determined.

9. CORDIA CAFFRA.—*Septee, Umnovunovu.* A small coast tree, usually leaning considerably. Timber durable as fencing poles, seldom large enough for other purposes.

10. CUNONIA CAPENSIS, LINN.—*Red Els, Umnqwashube.* Usually small, but where very old eventually a tree with bole of large diameter and short length. Scarce in Natal. A pretty red furniture wood; used also for spokes and other wagon work. An ornamental evergreen tree, producing its spikes of white flowers in abundance. Grows usually near the margin of the forest, or in mountain streams, but is liable to suffer from frost while young.

11. CURTISIA FAGINEA, AIT.—*Assegai-wood, Umgxina.* A large evergreen tree, frequent in the Yellowwood forests and in mountain ravine bushes. Timber always in demand for spokes, as it shrinks less than other kinds. Tender to frost, and difficult to cultivate, but very ornamental when a nice young tree.

12. CYCLOSTEMON ARGUTUS, MULL.—*Umhlagella.* An ornamental evergreen tree of medium size, confined to near the coast, and only used for local purposes.

13. EKEBERGIA CAPENSIS, SPARM.—*Dog Plum, Umgwenyuizenja.* A large evergreen tree, of rapid growth; most frequent near the coast, but extending also into the mist-belt forests. Timber soft, light, white, used for boards, planks, furniture, etc., and fit, with creosoting, for railway sleepers. Grows easily from truncheon cuttings; also from seed.

14. ELÆODENDRON CROCEUM, D.C.—*Saffron-wood, Umbomvane.* A large evergreen tree, frequent throughout Natal, and easily recognised by the yellow colour of the under bark of the stem, and which shows also on the surface, as also by its large white fruits. Timber close-grained, heavy, hard, and strong, used in wagon-work and boat-building. Fit for use in wood-engraving. Not uncommon on the shale formation, and ornamental while young; afterwards much branched from a short bole.

15. EUGENIA CORDATA, HOCHST.—*Waterboom, Umdoni* and *Umswi.* The most common tree in moist localities along the coast, extending occasionally to the mist-belt forests. Immense quantities of this have been cleared off the North Coast to make way for sugar cultivation, and sold as fuel in Durban. Timber fit for many purposes if seasoned in water, otherwise subject early to insect attack. An ornamental tree, with glaucous evergreen foliage, white flowers, and purple fruit edible to children, but loses much of its beauty when away from water. Forms a large proportion of the swamp bushes of lower Zululand.

16. EUGENIA ZEYHERI, HARV.—*Isiduli.* A rather small tree, frequent in the mist-belt forests. Fruit scarlet, the size of a cherry, acidulous, edible, seldom abundant. Timber in demand for spokes.

17. EXCŒCARIA AFRICANA, MULL.—*Umtomboti.* A small tree frequent in the coast districts, producing scented, hard, heavy timber, used for local domestic purposes, and in great demand among the Natives even far away from where it grows, for wearing as necklaces and other ornaments or charms.

18. FAUREA SALIGNA, HARV.—*Terblanz,* (*Beukenhout*). A small tree, local in the lower districts in open scrub forest, and producing a beautiful grained proteaceous furniture timber. Abundant below Northdene. Possibly distinct from the Pondoland Faurea, which is a large tree, inhabiting dense forest, in which kind of situation this has not been noticed in Natal. *Terblanz* is the Knysna name, *Beukenhout* is in use in Pondoland, and no Natal name has been ascertained.

19. GARDENIA ROTHMANNIA, LINN, F.—*Candlewood Xelegengane.* An upright, unbranched, evergreen tree of considerable height, but seldom exceeding 12 inches diameter. Bole straight; timber brittle, very close-grained, heavy, hard, used for waggon-wood, and fit for engraving. Flowers large bell-shaped, pure white. Scarce, but well worth cultivation for its Lilium-like flowers.

20. HALLERIA ELLIPTICA, THUN.—*Kinderbesje, Umbinza.* A small evergreen tree, frequent around the forests, and by its evergreen and not readily inflammable foliage a fair protection against fire. Its brick-red flowers are produced freely on the old wood, and it is sometimes known as "Wild Fuchsia." Timber usually too small to be of technical value, used for skeys, etc. Fruits black, many-seeded, eaten by children. Makes a nice evergreen hedge when regularly trimmed, but rather slow-growing at first.

21. HARPEPHYLLUM CAFFRUM, BERNH (ODINA CAFFRA).—*Kaffir Plum, Umgwenye.* A tall, upright evergreen tree, the older leaves turning scarlet as winter comes on. When growing in the open it is inclined to branch low, and make a low, round-headed tree. Frequent in the lower districts, where its red fruits are eaten by children, and occasionally

made into jam; in the upper districts it is less common, but larger, and seldom produces fruit. The pretty red heartwood makes beautiful furniture, and is also used as waggon-wood, and for general purposes. The tree grows easily from truncheon cuttings, which are occasionally planted as fence poles, and so form a line of living trees on the boundary line. Grows also from seed, one from each fruit.

22. ILEX CAPENSIS, S. AND H.—*Water tree, Umduma.* An ornamental evergreen tree, growing only in streams or marshes, and usually within the forest, or in mountain ravines, though it occurs also down to the coast. Timber white, rather soft, light, and in use only for domestic purposes.

23. KIGGELARIA DREGEANA, TURCZ.—*Wild Peach, Spekhout, Imfeyenkomo.* Abundant as a large tree in the Drakensberg forests, frequent in the mist-belt forests, and also present, though seldom large, on the coast. Very variable; seldom ornamental, except in its compact mountain form. Timber pink, fit for planking, but not much used. Easily cultivated from seed, but liable to caterpillar attack.

24. LANDOLPHIA KIRKII, DYER.—*Rubber vine, Ibungu.* A rambling monkey-rope, trailing over other trees, and producing stems occasionally up to six inches diameter, from which the best South African rubber is bled. Frequent in Maputaland; not known to occur south of the Mkuzi River. For further particular see Chapter X. For illustration see "Agricultural Journal," April, 1905.

25. MILLETTIA CAFFRA, MEISN.—*Kaffir Ironwood, Umzimbeet.* Usually a small crooked tree on coast shale formations; occasionally a fine tree on deeper soil derived from that. Heartwood very hard, heavy, dark-red, turning black on exposure, small in proportion to the white sapwood, used for spokes, but not suitable to use with flat-crown naves. Umzimbeet walking-sticks showing both colours are a favourite kind with both Europeans and Natives, but wasteful of timber. Easily raised from seed; its further cultivation has hardly been tried.

26. MIMUSOPS OBOVATA, SOND.—*Red Milkwood, Umtunzi,* and *Amasetole.* A large evergreen forest tree, not uncommon throughout Natal, and in demand for felloes and other waggon-wood. Ornamental as a small tree in any stage, especially when set with its numerous white flowers, or its red edible fruits. The various species of Mimusops yield a small quantity of rubber by bleeding the bark. Increased from seed, but grows slowly under cultivation.

27. MYRSINE MELANOPHLEOS, R.BR.—*Cape Beech, Isiqwane-wi-hlati.* Usually a medium-sized, spreading evergreen tree, growing on the outskirts of the forest, or a larger tree if inside the forest; frequent from the Upper Drakensberg forest clumps down to the coast. On the Walmer drift-sands, Port Elizabeth, it is reduced to a many-berried shrub

of two feet height. Timber grained like the Proteaceæ, hence the name Isiquane, for Protea, and Isiquane we-hlati for Myrsine; hence also the use of the name Beukenhout for Faurea in Pondoland, though applied elsewhere in Cape Colony to Myrsine. The timber is used for furniture, waggon-wood, etc.

28. NUXIA CONGESTA, R. BR.—*Bogwood, Omkobess.* Is a small tree, usually confined to hot, rocky ridges. It has a very close-grained white timber, suitable for wood-engraving and similar purposes. The white flowers are rather conspicuous during winter. Timber used for fencing poles in the Transkei.

29. NUXIA FLORIBUNDA, BENTH.—*Vlier, Umquaqu.* A small tree, most frequent in the lower districts, used as waggon-wood, but well worth cultivation for its fine foliage and masses of pink flowers, which are freely produced during winter, and bring a tree into notice from a long distance.

30. OCHNA ARBOREA, BURCH.—*Cape Plane, Redwood, Umhlazane,* and in Zululand *Umtelëlë.* A small tree, seldom over 40 feet height and 10 inches diameter, scattered at considerable distances through the forests, and always in demand for spokes. Usually evergreen, but occasionally loses most of its leaves, and then flowers freely on the bare wood. Flowers produced in quantity, orange-yellow, showy in mass. Tree worth a place in any garden on account of its flowers, and also on account of its red calyces supporting black fruits.

31. OLEA LAURIFOLIA, LAMK.—*Black Ironwood, Igqwanxe.* A large evergreen tree, not common in Natal. Timber heavy, hard, and strong, imported from Knysna for waggon-work and implement and machine frames.

32. OLEA VERRUCOSA, LINK.—*Wild Olive, Umqumu.* Usually a much-branched tree, with short bole reaching two feet in diameter with age, but usually decayed in the centre when that size. A denizen of hot, rocky kloofs, often standing alone, seldom crowded or included in dense forest. Splits into very crooked but durable fence-poles; the timber where straight enough is also used for waggon-parts, machinery bearings, cog-teeth, etc., for which the branches are useful. Tree very slow growing.

33. OLINIA CYMOSA, THUNB.—*Red-Berry, Satyobe.* An evergreen tree, usually branching low, and having a thick bole of short length; occasionally it has a good bole, and forms a large tree. Most abundant in the Drakensberg forests, whence it is extracted for fencing poles, and also for waggon-wood. Flowers pinkish, in trusses, sweetly hyacinth-scented; berries scarlet, like Hawthorn-berries, abundant in mountain localities.

34. OREODAPHNE BULLATA, N. AB. E. (OCOTEA BULLUTA). —*Black Stinkwood.* A large evergreen tree, scarce in Natal, except in the forests on the Griqualand East border. Timber of first importance, but seldom procurable in Natal forests in

such sound scantlings as those imported from Knysna. Preferred for waggon-work, yokes, and furniture, and always in demand. Seeds almost invariably destroyed by maggots, even before they fall. Artificial reproduction is, therefore, almost impossible; though in the natural forests seeds often germinate and live while the maggot is in the cotyledons, and before it has reached the germ. Planting is consequently practicable only by removing self-sown seedlings of this nature from the natural forest to where they are wanted. Stinkwood likes a good deal of light, and usually grows high up in the forests, above the zone of nearly pure Yellowwood, and more or less into the broken rocky ridges, wherever deep soil is available.

35. PLECTRONIA OBOVATA, KLOT.—*Qwar, Umbonemfene, Xululembilë.* A small evergreen tree, with straight, corrugated stem, frequent in the mist-belt forests, and also present as a low, much-branched bush on the coast dunes. Timber very close-grained; used for general purposes, and fit for wood-engraving.

36. PODOCARPUS ELONGATA, L. HER.—*Common Yellowwood, Umkobo.*

37. PODOCARPUS THUNBERGII, HOOK.—*Real Yellowwood, Umsunti* (Fig. 86).

These two species form the chief ingredients in what are known as the Yellowwood forests, and enter, more or less, into the composition of every forest from the coast to the Berg. Sometimes, as at Ixingina Forest, Polela, P. Thunbergii, forms almost pure forest along the lower mountain slopes, but more frequently the two species are more or less mixed with many other kinds, while coastward they usually occur as single trees scattered through forests of broad-leaved species. These two species supply all the Yellowwood planking and quartering on the market; they entered largely into the domestic timber supply of the Colony before importation began, and even now do so to a considerable extent. A measurement of the standing stock on a sample acre at Ixingina shows:—

Podocarpus Thunbergii, 68 trees of timber size, containing 5,750 cubic feet.

Podocarpus Thunbergii, 67 saplings.

Podocarpus elongata, 1 tree, containing 225 cubic feet.

Celtis rhamnifolia, 2 trees, containing 64 cubic feet.

Celtis rhamnifolia, 1 sapling.

Xymalos monospora, 2 trees, containing 85 cubic feet.

Toddalia lanceolata, 5 saplings.

Zanthoxylon capense, 1 sapling.

Unreserved kinds, 149 saplings.

In cultivation both species of Podocarpus grow slowly into rather ornamental trees, but P. Thunbergii has a variety known as P. falcata, common in the Griqualand East and upper Natal forests, which is more rapid in growth, and much more ornamental than either, its long drooping leaves and

dense habit (Fig. 94) giving it a graceful effect equalled by few exotics, and by no other indigenous tree.

38. PTEROCELASTRUS VARIABILIS, SOND.—*Kersenhout, Itwyina.* A small spreading evergreen tree, frequent in the mountain forests, but not much used for timber purposes.

39. PTAEROXYLON UTILE, E. AND Z.—*Sneezewood, Umtati.* Well known for its most durable timber, which, for fencing poles, gate posts, and other similar purposes, stands unrivalled. It is not uncommon in the upper and more rocky portions of most of the Natal forests, and also occurs occasionally on deeper soil coastward, but the demand for poles is always in excess of the supply, and consequently Sneezewood of timber size is now scarce in all accessible forests, and large poles command high prices. It is not difficult to raise from seed, but its subsequent culture is a puzzle, some few specimens doing well, but a much larger proportion fail to make satisfactory growth. One of the largest planted trees is at Mr. Ford's, Chase Valley, growing on a deep moist bank. It is never ornamental, and its culture can only be recommended to those who wish to try their skill.

40. PYGEUM AFRICANUM, HOOK.—*Bitter Almond, Dumizulu.* An evergreen tree, with dense shining foliage closely resembling that of the Portugal Laurel. It is frequent in the mist-belt forests, but has been so much in demand for felloes,etc., that sound trees of large size are now difficult to find. It grows easily from seed, prefers to be near a stream, and is worth cultivation as a foliage tree or as a hedge plant.

41. RHUS LÆVIGATA, LINN.—*Red Currant, Umhlakoti.* A large tree, frequent in the forests, and also present in the coast bushes. Heartwood red, pretty for furniture, and also in use for domestic and native purposes.

42. RHUS LONGIFOLIA, SOND.—*Isi-fuce.* A large evergreen tree, the older leaves turning red in autumn. Abundant towards the coast, extending also into the upper forests. Timber used for planking, etc., and for furniture, and the sap of the bark used by the Natives as a depilatory. Easily raised from seed, and worth cultivation as a foliage tree while young, as also when older.

43. SCOLOPIA ZEYHERI, ARN.—*Thorn Pear, Iqumza elinameva.* Seldom a large tree, though usually of timber size, except on the coast dunes, where a smaller form without thorns is more prevalent. Seldom an ornamental tree, and the hard knots from the thorns interfere somewhat with the value of its timber as a waggon-wood.

44. SCOLOPIA MUNDTII, ARN.—*Red Pear, Iqumza.* A very large tree when fully mature, evergreen, and ornamental. Timber in demand for waggon-work. Frequent in the upper forests, but sometimes also found down to the coast.

45. SIDEROXYLON INERME, LINN.—*White Milkwood, Umquashu.* An ornamental evergreen tree, resembling *Uluzi* Ficus, but producing a highly valuable and durable timber,

useful for boat building, waggon-work, poles, etc. Frequent on the coast, and extending along the hot, rocky ridges skirting the river valleys.

46. STRYCHNOS HENNINGSII, GILG.—*Hard Pear, Umnonono.* A large tree, notable in the forests by its usually heavy crop of yellow berries. Timber durable, forming a first-rate fencing pole. Common in the Nkandhla and other Zululand forests; now more scarce in Natal.

47. TABERNAEMONTANA VENTRICOSA, HOCHST.—*Mkahlu.* A small tree, with rough bark and showy white flowers; frequent in swampy bushes near the coast, and up to Pinetown and Eshowe. In Amatongaland it is considered a probable source of commercial rubber, and is therefore reserved.

48. TODDALIA LANCELOTA, LAMK.—*White Ironwood, Umzani.* A common and ornamental evergreen tree in the coast bushes, extending also into the upper forests as a much larger tree. Timber tough, suitable for handles, etc. Easily cultivated from seed, and grows in the open better than most kinds.

49. TRICHILIA EMETICA, VAHL.—*Essenhout, Natal Mahogany, Umkuhlu* (Fig. 43). A large tree, of heavy massive evergreen foliage, forming grand specimens throughout the coastward districts. Yields a valuable furniture and planking timber, in large sizes, but this is subject to insect injury unless seasoned in water. The bark is poisonous, and neither birds nor monkeys eat the large scarlet seeds, from which seedlings are easily raised.

50. XYMALOS MONOSPORA, BAILL.—*Lemonwood,* or *Bogabog, Uveto.* An ornamental evergreen tree, too common in the moister portions of the mist-belt forests. It yields a pretty yellowish furniture timber, but takes years to dry, and is consequently not in demand. Its canopy is so dense that other kinds will not grow under it, so when valuable kinds are extracted the forest becomes more and more a pure forest of unsellable Lemonwood. The extraction of Lemonwood would do the forest good wherever it exists, and it is to be hoped that a demand will arise before long for its timber. It is found when used fresh to be fairly durable as a round sleeper for forest tramways, probably because it never becomes dry.

51. ZANTHOXYLUM CAPENSE, HARV.—*Knobwood, Umnungu-mabele.* A large tree when grown in the forest, a shrub or small tree when growing in the open. Very variable. The large knob-thorns on the stem are very marked in forest trees. Timber yellowish, used in wagon-work, etc. A tree possessed of ornamental foliage in each of its varieties, and easily raised from seed. Grows alike on the coast sand-dunes, and the dry, shallow shale soils, and in the deeper and moister forest glens.

52. RED IVORY.—*Um-nini.* A small tree of the thornveldt and coastward districts, producing hard, heavy, red

timber of small size. Not yet identified botanically, and local in its distribution.

Although the above-mentioned trees are reserved in the Crown Forests, on account of having technical value, many other kinds are of equal interest to him who desires to use indigenous trees in the ornamentation of his grounds. Among these may be mentioned:—

ERYTHRINA CAFFRA.—*Kaffirboom, Umsinsi* (Fig. 51), which forms a striking feature in the coastward districts during spring on account of its profusion of scarlet flowers; it makes a fine tree where favourably placed, and is usually deciduous. Its timber is only fit for brake-blocks. It propagates easily from cuttings or seed.

ERYTHRINA HUMEI, is a shrub of 4 to 8 feet in height, but even more gorgeous in its profusion of spikes of crimson flowers; it belongs to the midlands rather than the coast, and is easily raised from seed. It usually grows among rocks, producing a large crown underground. A smaller species is E.)Zeyheri, of the upper districts, which from a huge underground stem-crown, throws up a few herbaceous twigs ending in equally showy flower-spikes. E. latissima is conspicuous rather by its large leaves than by its flowers.

HIBISCUS TILIACEUS.—*Umlolwa,* has been already referred to as a useful street tree in Durban and on the coast (Fig. 85).

BAPHIA RACEMOSA.—*Isi-fiti,* is a leguminous shrub of the coast districts, producing abundantly its white or lilac sweetly scented flowers.

TARCHONANTHUS CAMPHORATUS.—(Fig. 51.) Produces a striking colour effect through its foliage being nearly white. It grows abundantly along the coast dunes and for some distance inland, usually as a large bush, but occasionally as a small tree.

ZIZYPHUS MUCRONATA.—*Umpafa.* (Fig. 50.) Occasionally forms a large spreading tree, as in the illustration, but more frequently assumes the same form and size as the Mimosa. On alluvial soil it makes a good prickly hedge, but does poorly on dry ridges.

CUSSONIA.—Several species, known as *Cabbage-trees, Umsinga,* have most ornamental foliage of a distinct type not represented in any exotic grown here. Were they not common as native trees they would be in demand in horticulture. They grow easily from seed or from base cuttings.

MACARANGA (MAPPA) CAPENSIS.—A coast tree, usually growing in moist localities, and producing there large glossy-green leaves. Ornamental where healthy.

SCLEROCARYA CAFFRA.—*Umgani.* A coast tree, with foliage like the Ash, and fruits from which the Natives brew an intoxicating liquor.

ACOCANTHERA (TOXICOPHLOEA) SPECTABILIS.—*Intlungunyembe* or *Ubuhlungu benyoka.* One of the prettiest and most

sweetly scented flowers of the forest. Usually a shrub, occasionally a small tree; flowers white, very numerous; berries purple, like plums, and therefore dangerous, since they and all other parts of the tree are highly poisonous. Worth a place in any garden where children are not allowed.

CLERODENDRON GLABRUM.—*Um-qwaqwana.* A large shrub or small tree, common near the coast, producing abundantly its clusters of pretty white flowers. Worth cultivation.

PEDDIEA AFRICANA.—*Umtozane.* A shrub not uncommon in bush country, producing pretty and sweetly scented yellow flowers.

CASSIPOUREA VERTICILLATA.—A scarce coast tree, which makes an ornamental specimen or street tree, especially when its yellow fruits open, showing the red seeds.

DOMBEYA.—The several species are shrubs or small trees, and all worthy of cultivation as flowering plants. Flowers white or pink, like Abutilons, and freely produced.

TURRAEA HETEROPHYLLA.—*Wild Honeysuckle.* Is a free flowering bush or small tree, conspicuous by its abundant, sweetly scented yellowish flowers like those of Honeysuckle.

TURRAEA OBTUSIFOLIA is a smaller, more compact, ornamental, white-flowered species common near the coast.

DAIS COTINIFOLIA, often a small shrub, occasionally a small tree, with good foliage and pretty pink heads of flowers.

PAVETTA, several species, are known as Christmas-trees on account of the dense profusion of their white flowers at Christmas time. Shrubs or small trees.

SCHREBERA ALATA.—A free flowering shrub of the coast districts.

GREYIA SUTHERLANDI.—A small tree common on high rocky localities and producing freely during winter its showy spikes of scarlet flowers. Well worth cultivation, and not difficult to grow by cuttings or roots.

MILLETTIA SUTHERLANDII.—One of the largest trees of the warmer districts, having fine foliage and pendant clusters of purple flowers, but, unfortunately, its timber is worthless. There are good specimens in Eshowe bush.

SCHOTIA BRACHYPETALA, SOND.—*Um-xamo.* A free flowering shrub or small tree, conspicuous by its scarlet sepals.

MABA NATALENSIS.—A small upright tree, with horizontal branches and small, glossy leaves, resembling those of English Box.

DOVYALIS RHAMNOIDES and D. ROTUNDIFOLIA.—Both known as *Zuurbesjes, um-nyezane,* are shrubs or small trees, producing small scarlet berries in abundance, which are pleasantly acidulous and used for jam making.

BARRINGTONIA RACEMOSA.—A small tree growing around the saline coast swamps, having most ornamental habit and foliage, showy white eucalypt-like flowers, and large hard fruits, not unlike small pomegranates.

COMBRETUM KRAUSSII, *Bush Willow, Umdubu,* is a large tree common in the midlands, and extending also to the coast and to the mountains. Leaves and winged fruits turn red in autumn, hence the Dutch name "*Roodeblad.*" Timber not much used, heavy, hard.

The above are only a few of the numerous wild shrubs and trees well worth cultivation among others which attract attention in the forest being Gardenia globosa, G. Neuberia, G. Rothmannia, and various species of Jasminium, all for their scented white flowers; Burchellia capensis and Tecoma capensis for their red flowers, Alberta magna for its red calyx lobes, Plumbago capensis for its blue flowers, Carissa grandiflora, for its white flowers and prickly-hedge qualities, Kigelia pinnata for its curious cucumber-like fruits, Protea on the mountains for their well-known sugar-bush flowers, Panax Gerrardi for its fine foliage, Ochna atropurpurea and species of Calpurnia and Lasiosiphon for attractive yellow flowers, Grewia, Polygala, etc., for purple flowers, and Capparis and Niebuhria triphylla for flowers mostly composed of fantastic white stamens. These and many others are worth the attention of the Natalian sufficiently patriotic to form and maintain a garden of indigenous trees and shrubs.

CHAPTER XXI.

URBAN AND SUBURBAN HORTICULTURE.

(Read before King William's Town Horticultural Association, Cape Colony, 1898.)

It has been well said "God makes the country, but man makes the towns." In other words, the country is the home of nature, while the town is altogether artificial. Horticulture is also artificial in its nature; it transfers plants of all kinds from their natural conditions of life to the artificial existence they have to live in gardens, hence it must be considered to belong more properly to suburban than to rural life. But as a matter of fact the love of horticulture is inherent to all mankind, the first members of the race having received instructions to till their gardens as due punishment for misdeeds, and their posterity have displayed a most marked hereditary tendency to keep up both the misdeeds and the punishment on their own account; even to the extent sometimes of taking a pleasure in the punishment, while forgetting that it is such in nature, or how it originated. If, then, there are more difficulties in making horticulture successful in town than in the country, let those who experience these difficulties think of them as their due deserts.

Since the subject selected for to-day is "Urban and Suburban Horticulture," one naturally enquires if there be anything distinctive about these, or if there be any point or points on which they differ from horticulture in general, and though at first sight there appears to be a general sameness, still a closer inspection reveals considerable differentiation.

Thus, economic horticulture, such as the growing of vegetables and fruits is a matter of necessity in the country—one must grow these things or go without; whereas in town if one prefers an ornamental garden to an economic one, he may obtain on the market or from the market-gardener whatever he may require of an edible nature.

Again, in the country if one wishes to have a garden at all he usually has to lead the water up to his house, or else have the garden away down in some moist spot at a distance, frequently out of sight, or too far away to allow of its being under constant and unexerted observation, whereas the town garden is alongside the house, and under the water supply when there is one.

Then, again, in the country one frequently has in view a landscape 30 miles wide, without any controlling or cen-

tralising features, and in the midst of such a vast area a garden, however nice, is lost in its comparative insignificance to the extent of the general view, and one is irresistibly led to follow that first master of scenic garden art, who is said to have "leaped the fence and found all nature was a garden," whereas a town garden of similar extent and beauty, surrounded by enclosures, neighbouring buildings, walls, and trees, constitutes often the whole visible world to its indoor occupants; each feature, whether good or bad, is distinctly forced upon them, and except they look upward there is no possibility of gazing into unlimited space and losing therein the attractions—or distractions—of the more immediate surroundings.

So, on each of these points the town lover of horticulture has an advantage over his country cousin in the making of the amenities to his home, be that home grand or humble.

But, because the view is necessarily circumscribed there is all the more reason why it should be at once æsthetic and self-satisfying; why the unavoidable concomitants of town life—brick walls and iron roofs—should wherever possible be kept in the background by trees or creepers; and why the whole available balance of space should be an artificially natural little *rus in urbe* instead of a minature market-garden or a gravelled parade ground. Naturally no hard and fast rule can be laid down as to how this is to be accomplished, for, as the tastes as well as the spare cash of individuals differ, so must their gardens, but it by no means follows that the nicest and best kept gardens will belong to those with most spare cash; very often the reverse is the case, and why? because natural simplicity and pure beauty are the first elements of scenic horticulture, while cash very often carries along with it a tendency to replace these by unnatural, gaudy, or ostentatious display.

In any natural scene the groundwork is green; green leaves, green shrubs, and green trees; enough green everywhere to form a setting for whatever of the more highly coloured nature may be introduced, and of these coloured elements only just enough to have their natural characteristics strongly marked out against the green. "Nature is always temperate in the display of high colour. The rainbow is evanescent. Dewdrops sparkle only at a certain angle of vision, and soon evaporate. A gorgeous sunset covers but a small portion of the heavens, and lasts but a few minutes, and the exhibition is not opened daily, or even weekly. For a week or so in autumn there is a brilliant display of colours in the foliage of trees and shrubs; but the duration of the brightest tints in any leaf is very brief, and the whole display is but a fleeting show." So also in nature is the floral exhibition usually sparingly displayed and of short duration; hence the abundant and never-absent green. In Nature's own setting all things are beautiful.

But town life has a tendency to polish off everything natural. Even in man this is the case; he becomes in town more formal, more systematic, more exact, and more up to date, or else sinks into slovenly negligence, and his garden has to follow suit; it also must become more formal, more systematic, more mathematically correct, and less natural, or else become a neglected waste in accordance with the taste of its owner. But it is perhaps well that it is so, for how is it possible to do other than follow geometrical lines in the laying out of a small rectangular plot, placed between two parallel straight streets, and occupied in part by a square or at least a rectangular building.

Unless the garden be a large one, regular outlines must prevail, and even in a large garden carefully thought out and effective irregularity is more difficult to attain than mathematical precision, although it is infinitely preferable in extensive landscape work.

In laying out a suburban garden, it is necessary to remember that if the town has not already planted trees along the street, it most probably will do so some day; and in the planting of any trees, to arrange that they be not near enough the street boundary either to injure or be injured by the street trees when these are in evidence; for it must be recognised that since everyone can lay out his own garden according to his own taste, the municipality ought to exercise the landscape gardener's art in so arranging its tree-planting operations as to tone down, smooth over, and hide away, all striking incongruity in neighbouring properties, and form a harmonious whole out of a number of dissimilar units. A recent writer states this nicely thus:—Horticulture, Architecture, and (in the suburbs), Agriculture, should blend in triple alliance, by gradual accommodation producing uniformity without formalism, a concert of many instruments in perfect harmony, a combination

> Where order in variety we see
> And where, though all things differ, all agree.

Unfortunately, this view of municipal tree-planting has not yet been fully realised by those in charge of the work in almost any of the towns in this Colony,* but it is well recognised abroad, and its adoption here is only a matter of time and social progress.

It is in this control of the main feature of municipal horticulture (street tree-planting) and in the control of its water supply that any municipality has the means of making or destroying the attractiveness of the town from an æsthetic point of view. I do not mean that an unlimited water supply is essential to successful horticulture; indeed, in almost all towns more harm than good results from unlimited water, for where, as is usual, there is no drainage, it is almost impossible

*This was written in reference to Cape Colony.

to irrigate frequently without occasionally producing soil saturation, and a condition in which plants, and more especially trees, cannot for long be kept in good health.

But it is also requisite that water should be available when necessary, hence the municipality has a duty to maintain a constant supply and at the same time prevent wasteful and injurious excess.

The bad health consequent upon saturation, or irregular water supply, is the primary cause of most of the troubles to which town gardens are subject. It does not, of course, *produce* either insect or fungoid pests, and could not do so except spontaneous generation were admissible, but it produces a condition in which, with regard to most of these pests, when one has once obtained a footing, it is more at home, and flourishes more luxuriantly than it does where its host plant is in perfect good health. Australian bug, scales of all kinds, potato disease, fusicladium on fruit trees, orange root rot, mildews, rusts, greenfly, and even frost, are all either encouraged, or increased in intensity of attack by bad health following either saturation, or alternate saturation and drought.

There are a few other pests, such as peach maggot, pear slug, American blight, and most of the larger caterpillars, which affect healthy and unhealthy trees alike, but these, like scab, ticks, and other noxious parasites, spread most easily where their hosts are in contact or proximity, and hence are more generally distributed in town gardens than elsewhere.

Some garden pests are easily cured with care in the application of remedies now well known, others are almost incurable, and it is quite evident that no insect pest ever will be eradicated until a measure as drastic as the scab act comes in force, not only with regard to nurseries, but to gardens in general, either with or without local option. If it be not legal for farmers to cultivate scab for their neighbours detriment, no more should town inhabitants be allowed to cultivate and maintain pests, which from their ubiquitous nature, are the main deterrent to the expenditure of capital, science, and energy, on otherwise highly profitable orchard work.

Municipal horticulture as distinct from street tree-planting (though often connected with it) is mostly represented in this Colony by what are called by courtesy Botanic Gardens, These institutions* have had a most useful past in the introduction and dissemination of the various economic and ornamental products of horticulture; but since that function is now better performed by private nurserymen who usually can afford to speculate more than the gardens can, and since the Government grants in aid are in almost every case spent on ornamental work, while the work of introduction and dissemination is confined to more or less unsuccessful endeavours to augment the garden revenue, it would be a distinct advantage

*This was written in reference to Cape Colony.

alike to the towns themselves, to the nurserymen, to the purchasing public, and to the cause of horticulture, if these gardens were treated as public pleasure parks, pure and simple, and without any sale department, while with regard to the name, in some of them at least, since they are the very hotbeds of insect pests, perhaps Zoological Gardens would be less of a misnomer than the present title. Something in the nature of a pleasure park is, however, almost a necessity in any well regulated sunny South African town, and becomes more so as the town enlarges, as for instance in Cape Town where open spaces are becoming scarce, and where what used to be the Botanic Garden is now in popular demand, not so much for its botanical character, or its rare collection, as for its general air of quiet ornamental shady retreat, where all is busy life and bustle around; and if too much ambition be not introduced, there is always the possibility of securing ways and means.

In the United States the "prettiest gardens on earth" are run by rival speculating Companies, out of town, and at enormous expense upon the horticultural operations, under the name of cemeteries, and their only revenue is derived from the sale of plots for the interment of the more wealthy inhabitants, or in some cases from gate-money. Still, these cemeteries draw thousands of visitors and pleasure parties; they are the most rural delights attainable by many a hard-sweated city resident, too poor to ever dream of affording a plot there either for himself or his relatives; they allow the possibility of one being buried in a spot having more the appearance of paradise regained than the usual purgatory; and what is of more importance to the average Yankee they are a large source of revenue to the tramway companies, and return good dividends to their own shareholders.

In this Colony,* however, the Government does so much to encourage the horticultural decoration of towns in the form of tree-planting that, according to present arrangements, any town or village can expend up to £500 per annum upon approved work of this nature, and receive from Government a refund on the pound for pound principle, while in most of the larger towns an additional vote is also provided for the encouragement of horticulture in the shape of parks or gardens.

But to return from extensive landscape and municipal work to the more intensive possibilities of a private garden, and more particularly of the garden of him who follows horticulture as a pleasure rather than a means of subsistence, there is always the possibility in towns of obtaining plants of any desired kind; there is always manure at hand; there is always labour obtainable, both skilled and unskilled, and there is almost always water obtainable in sufficient quantity; so no reason exists why there should not be done anything or everything which the climatic conditions of any particular district admit.

*This was written in reference to Cape Colony.

The only factors having an injurious effect, besides the insect pests and excess of water already referred to are dust, wind, and the excess of heat reflected off iron; but all these can be controlled.

Wind and dust go more or less in company; at least it is only where dust is kept in rapid motion by wind that it does much damage, and in most places that can be checked, or the damage reduced, by a close hedge wind-break where there is room for such, or by one or other of the numerous kinds of screens where space is too limited for a hedge.

Even verandah plants, in a thoroughly busy, windy, and dusty street, are sometimes kept in perfect health by a simple screen, together with a regular shower bath every morning, delivered from a watering-can rose, while in a site where all else fails, a glass greenhouse finds its most fitting use. Even if a greenhouse be beyond the means of him who has a hot dusty wind-swept corner, he may still prove the survival of the fittest and at times have a magnificent display of bloom, by fixing up an elevated bank, set with rough stones and getting the crevices between these occupied by species of Mesembryanthemum, Aloe, Cactus, Cereus, Stapelia, Crassula, Euphorbia, and other unique and grotesque forms of vegetable life, produced by somewhat similar carroid surroundings and individually as rigid, formal, and many sided, as the most polished townsman. But there are certain plants among the usual decorative class, which stand dry dust storms much better than others; thus among verandah plants Dracenas, Hardy Palms, Geraniums, Begonias of the Weltoniensis type, and Hydrangeas, stand much better than do Coleus, Rex Begonias, Fuchsias, or tender Ferns; but where wind or dust storms are frequent even the tender things become acclimatised to these, and thrive well, if less vigorously than where completely sheltered; whereas plants which have been under shelter suffer much anywhere if suddenly exposed to rough wind.

As a wind-break hedge, Privet is probably the best for most situations, but Kei Apple and Hakea are also good where frost is nearly absent, while closely cut Aleppo pine, Cupressus Macrocarpa, or Arborvitæ are particularly suited for some of the up-country districts in which Privet is apt to become deciduous during winter. Other equally pretty hedges such as Pomegranate, Myrtle, English Box, and Australian Myrtle,, are better kept for sheltered positions, while Golden Willow, though pretty where it does well, is so apt to die out in patches and leave irreparable gaps that its use cannot be recommended anywhere.

But in many town gardens where there is little room for an ordinary hedge a very pretty and effective hedgelike screen is formed by training creepers along any kind of wood or iron fence or trellis. As a protection for a verandah, or for the purpose of secluding a portion of a small garden from the public gaze, nothing can beat this simple contrivance, and

the effect of such a living shelter upon the wind is very marked. The plants which may be so employed are very numerous, but among them may be mentioned various climbing Roses, the smaller Bignonias, especially B. jasminoides, Asparagus plumosus, Mandevillea, etc., while, if early effect be desired, such common annuals as Nasturtiums (Tropæolums) and Convolvulus are quick and effective.

For still larger trellis work, such as for covering trellis covered verandahs, hiding bare walls or unsightly back premises, such as are hardy enough of the following may be used, viz.:—Wistaria, Bougainvillea, the large Bignonias, Banksian, and various Tea Roses, Jessamine, Clematis, and many others. For adhering firmly to a brick wall Ampelopsis Vietchii (the Japanese Virginian Creeper) is good, while Ficus microphylla and English Ivy both like walls more damp than is desirable for house buildings.

With one or more of the above, judiciously used, and assisted by trellis work, almost any erf or corner can be completely secluded without much space being taken up, or the inside view of the erf interfered with.

But even in a small garden it is not desirable to have everything in view at once. Someone sarcastically says:—

"The garden next your admiration calls,
On every side you look behold the wall,
No pleasing intricacies intervene,
No artful wildness to perplex the scene,
Grove nods at grove, each alley has its brother,
And half the platform just reflects the other."

A few trees, however, some rambling creepers, flowers in variety, but not too much in mass, and where there is room a bit of green, lend a rural air to many a suburban residence which would be unattainable were the surroundings all in sight or the inside view unbroken. Even a vine arbour may be used, at once for fruit supply and as a break. This, again, introduces the question of whether economy or æsthetics take precedence in the laying out.

A story is told of a rapidly rising American, who, having built a splendid residence, called in a landscape man to consult with him about the surroundings. Various arrangements were made concerning the fruit and vegetable garden, and they arrived at the floral decoration of the walls and verandahs of the house itself. Several creepers were named as suitable, till the owner enquired "Do those things eat," and on being informed that they were for show and not edible, curtly replied, "Well, I guess we won't have those things here." There is, unfortunately, a widespread tendency to ape this gourmand in selecting mostly what will eat, hence we often find town gardens so crammed with seedling peach trees that the owners and the fowls together cannot eat up all the peaches and their accompanying maggots.

There is certainly an undefinable pleasure in being able to sit under one's own vine, but the pleasure is modified much when that vine and fig tree are simply alive with ants and other vermin, and when sitting thereunder requires passive indifference to the accidental invasion of one's person by these peripatetic scavengers.

Whether fruit trees and vegetables should be introduced depends partly on the extent of the garden and partly on the taste of the owner. Vegetables will grow, and fruits also may be kept intact in a town garden, but except the garden be a large one, or the owner desperately in want of manual exercise to relieve his superabundant energy, it is better to leave these operations to the professional market-gardener, and confine the endeavour to ornamental work.

Many townsmen endure miserable and unprofitable fruit trees under the idea that they are inseparable adjuncts of the garden, and they also keep on sowing and planting vegetables for the family cats and the neighbours' fowls to re-arrange, while any crops that are obtained cost four times market value. How much more delightful is it to exclude these, especially in a small garden, and to make it by floriculture the home of repose and beauty, instead of the scene of perpetual hard labour in vain.

This is most easily accomplished by the abundant use of shrubs, herbaceous plants, and bulbs—common enough kinds it may be, such as Roses, Dahlias, Chrysanthemums, etc., along with grass where there is room. These all survive year after year the worst endeavours of the cats, the fowls, or the phylloxera; they only require an occasional digging to keep the soil clean and fresh; they only require an occasional watering during dry times to keep them alive, and if there be a choice selection planted there will be a good display at all times, which can be eked out as necessary by free flowering annuals. But above all things do not persist in town in trying to succeed with something which defies success. Such an endeavour is all right in the country, but in town it is cruelty to one's self and to whoever else can overlook the experiment, and it may prove fatal to the good name of the plant you are endeavouring to foster, while there are so many others which may be relied upon to return your kindness at once.

But if one has some horticultural skill, and if he has the desire and the ability to introduce something new, or reinstate something old, into local gardens, there are plenty of subjects ready to hand in the wild flora. One cognizant of the peculiar horticultural fads which were in vogue in England during the first half of the present century cannot help being struck by the total absence in South African gardens of the favourites abroad of that period, and this is all the more surprising since they mostly belong to South Africa. The Pelargoniums, Heaths, Proteads, Mesembryanthemums,

Crassulas, Stapelias, Aloes, Gladioli, and other Irids, Amaryllids, and Liliaceæ, raised a furore in European horticulture, while they were and are totally ignored in this, their native land, simply because they are Afrikander; but even to-day they are not surpassed in beauty by anything we have in cultivation, and he who can show in a local garden a living collection of Cape plants in the form in which they are sometimes exhibited at a London Show will exhibit patriotism and perseverance worthy of the strongest phrase of approbation that the *taal* posseses. This, however, involves hobby hunting, but it may be pointed out that it is not in the ordinary mixed garden that any particular kind is seen at its best, but rather in the garden of him who takes up as a hobby the higher culture of that particular kind, to the exclusion more or less of other equally good things.

I will not inflict upon you a list of the almost innumerable kinds suitable for town gardens, since everybody knows or can see for himself in other gardens what most exactly fits in with his own requirements; but I may be allowed to mention a few points which are sometimes overlooked.

Roses, of course, take precedence among the shrubs, and I find that there is a general belief prevalent that if one purchases, say, a dozen Hybrid Perpetual Roses, and treats them well, he will never be without blooms. Now no greater mistake could be made. Perpetual, in the sense of constant flowering, is a complete misnomer as applied to that class, which contains almost all the roses in cultivation that have only one short flowering season during the year; therefore, if you desire constant flowerers, or even frequent flowerers, carefully avoid Hybrid Perpetuals.

But again, if fine show blooms are desired, especially of dark red colours, and one is satisfied to get six or eight good blooms in a year from each bush, then select Hybrid Perpetuals.

Then, again, there is an idea that the best Tea, Hybrid Tea, and Noisette Roses, require warm sunny situations, whereas in fact most of them produce equally good or better flowers, and keep these flowers in form much longer, if more or less in shade, while some kinds, like Marechal Niel, Devoniensis, and Gloire de Dijon, seldom produce perfect flowers except in partial shade. Chrysanthemums have been improved in the most marvellous manner during recent years; and Cannas have been transformed from weeds into useful florist flowers.

Dahlias, being easily grown, but not easily killed or damaged, are common enough, but good ones are exceedingly rare, and the weeding-out process will not make much progress until somebody has the courage to destroy all the weedy Dahlias he has, and make an exhibition of first-rate kinds only. The popular idea here is that a single Dahlia is a weed, and that any approach at doubleness is highly merit-

orius. Quite the reverse is the case from a florist's point of view, which recognises in the quite single, as well as in the good double forms, excellent show kinds, but which discards all intermediate grades as worthless refuse. With Carnations also a mass of worthless half-double seedlings are held in high esteem, while good doubles are almost unknown. Among Flowering Begonias, any tuberous Begonia which bears a flower, however poor or washed out the colour may be, is considered a prodigy, while in most other places it would be thrown out as soon as it showed its first flower. Among Pansies also vast improvement is required, and though the climate here does not suit Pansy propagation in the way it is done in Britain, still it is surely possible to get rid of the mass of weeds usually seen, and work up to something better, for I have not yet seen many pansy flowers in South Africa that would have found places in any amateur's collection at an English Pansy Show.

Of course, all the above are points on which it may be argued that for any ordinary garden, the one form is as pretty or as showy as the other, and that only the professional florist could appreciate the differences named, but I would beg to remind you that as leaders of civilisation in what is now no longer a pioneer's country, if you wish to keep up with the times you must import the florist's idea as well as the florist's flowers; and this, I take it, is one of the main objects that Horticultural Associations have in view. We are admittedly behind in this respect, and our Shows and Horticultural Associations have much to do, more particularly in the direction of bringing the best products to the front, and discarding or discrediting those which are now outdated. Of course, the fact that the Colony was practically closed against the importation of plants for several years by the Phylloxera regulations, has a good deal to do with the present backward condition, even though we did occasionally hear at that time about the importation of cases of tinned goods labelled tinned vegetables, which vegetables only required exposure to moist air, and to be placed in contact with damp soil, to start them into active growth, and produce living Dahlias, Hyacinths, or Begonias, in accordance with the brand used. Now, however, that the restrictions are nominal, and smuggling consequently obsolete, the exceedingly rapid progress of horticultural development, within the past few years, requires the uninterrupted importation to here of all the most promising novelties suitable for the climate, and encouragement by local Associations to have these exhibited in good form as soon after production as may be. Do not understand me to say that we must send abroad for everything, and especially with regard to strains which have been long in cultivation, for whatever kind is obtainable locally is usually obtainable as good at hand as from the most noted seedsman or plantsman abroad, while

with regard to importation, unless each individual is prepared to import direct, the most suitable method is to give the local trade importer of horticultural novelties such support in what he does introduce, as will encourage him to keep up with the times.

One can hardly believe that it is only 94 years since the Royal Horticultural Society was formed in London, for the express purpose of itself introducing novelties into Britain, with results which have transformed the floral and forestal appearance and vegetable productions of the whole world. If local Associations accomplish anything for South Africa like what the Royal Horticultural Society has done for England, they may be satisfied. Still, it is well to keep in mind when starting to imitate that Society, that it has planted money as well as seeds, and that during its lifetime it has spent over £400,000; and that even with that expenditure its President, in reviewing its history, recently summed up that "It would enforce the lesson, that Societies, as well as individuals, if they are to prosper, must stick to their last, and cut their coat according to their cloth."

CHAPTER XXII.

ORNAMENTAL TREES AND SHRUBS.

Every tree and shrub is ornamental when in good form and set in appropriate surroundings; the selection of a limited number under the above title would, therefore, be invidious if these were recommended even to the exclusion of others. But there is no such intention. Many trees and shrubs have already been mentioned as combining beauty with utility; others have been mentioned for ornamental effect alone; many highly ornamental kinds have been mentioned as denizens of Natal forests as well as of Natal Gardens, and now a few garden favourites, or highly meritorious kinds, which have thus far been omitted are brought under notice, with a view to adding further beauty and variety in many a garden, but with no intention of excluding whatever does not appear on this or the previous lists. Eucalypts, Acacias, Conifers, and other trees have been treated as natural groups, and this chapter is devoted rather to a summary of those most suitable for a special purpose than to a description of each species, except in the case of shrubs not previously mentioned.

Trees form the permanent features of any garden or estate, and judicious or injudicious planting consequently tells on the general effect during the whole lifetime of the trees. Generally trees for ornamental work are planted too closely and thinned too late, the result being bare-legged trees, which are less ornamental than they should be. Abundant space while young, giving opportunities for the fullest development of all branches, is the best method of obtaining really ornamental trees, but as has been previously mentioned such have no technical value, and must be regarded as only ornamental trees, not timber trees. Shrubs having less size, and being more easily moved, can be used for filling the interstices, while the permanent trees are still young, but even these lose their beauty as soon as they begin to be dominated, when it is time for them to give place to black earth, or to grass if there be light enough. Well kept grass is the prettiest setting to any tree; clean ground comes next; except where an endeavour is being made to imitate nature by a wild profusion of intermatted greenery, irrespective of the form of the individual trees. But few men can imitate nature successfully; horticulture is essentially artificial; and success on the artificial plan is much more easily obtained and more common than success in the imitation of nature. But the essence of success is to use an original plan fitting in exactly with its own suroundings, consequently no stereotyped plan is recommended for any place, but rather the exercise of the owner's own ideas, producing if successful an effect

according to his own desire, and if unsuccessful showing him that he has still something to learn.

For specimen trees there is hardly a species which cannot be successfully used if used in the right place, but some are naturally more symmetrical, more striking, or more graceful than others, or have some other peculiarities favoured by the owner. Among these the Araucarias take first place, no other group combining sturdy regularity with graceful symmetery to the same extent as these. Other conifers, however, have equally pretty form, each in its own line, and where many species do well it is rather in judicious mixture than in adherence to one or a few types that a pleasing general effect is produced. The pyramidial form of the various Cypresses with dense fine foliage down to the ground, the more top-heavy growth of the Pines, and the compact habit of the Junipers, Taxodiums, Cryptomeria, etc., mix and blend well with trees of more heavy foliage, such as the Oaks, Loquat, Ficus, Grevillea, Magnolia, Catalpa, Liriodendron, Paulownia, Bauhinia, Spathodea, Cedrela, Poinciana, Mangifera, and others of that class.

As a striking background at a distance Eucalypts and Black Wattle are very effective, but for near effect these are too gross-feeders to intermix closely among those already mentioned, and especially among Conifers. As a class the Eucalypts can hardly be spoken of as making ornamental specimens, though as a mass, and viewed from a distance, they are very effective. But there are species among them, such as E. diversicolor (the Karri) and E. angustissima, which make beautiful specimens of quite diverse habit, and E. robusta (Swamp Mahogany) on the coastward flats is a picture of beauty. A red-flowered form of E. sideroxylon is worth culture for floral effect, though not equal to the gorgeous scarlet flowered E. ficifolia, which, however, has not done well here as yet, or the white-flowered E. calophylla, which also soon loses its beauty here.

The Black Wattle standing alone is always an ornamental tree, but loses much of that when crowded into plantations for the sake of utility. The other Acacias are mostly worth growing for floral effect, including several of the indigenous species, while A. saligna and A. cyclopis do well so close to the sea that other trees suffer unless protected by them. Among other trees fit for the coast sands are Eucalyptus gomphocephala and Casuarina equisetifolia. For growing on the mud of tidal lagoons the indigenous Mangroves take first place, including Rhizophora mucronata, Bruguiera gymnorhiza, Avicennia officinalis, and Barringtonia racemosa, the former having durable timber for posts and a fair percentage of tannin in the bark, while the latter is a most ornamental tree.

In addition to those mentioned in previous or subsequent chapters, the following shrubs are worth cultivation in gardens for floral effect, viz.:—

Name.	Height in feet.	Colour of flower.	Remarks.
Abelia rupestris	2—6	White	Free flowering and hardy.
Abutilon, many varieties	3—6	White, yellow, red, pink, purple, variegated	Beautiful hardy shrubs, with handsome flowers. Some have also foliage variegated with yellow.
Acalypha, several species	3—8	——	Handsome, tender shrubs, the foliage edged or variegated with red or yellow markings.
Acer. Japanese species		——	Several variegated and fine-foliaged kinds propagated by grafting are well worth cultivation as small trees.
Agonis flexuosa	10	White	A fine-foliaged shrub, like a small Eucalypt.
Allamanda, several species...	6	Yellow, or violet	Beautiful subtropical shrubs or creepers, very free flowering.
Aloysia citriodora	8	Small	Foliage highly scented ; known as the scented Verbena.
Amygdalus persica fl. pl.	8	Scarlet, white, or pink	Double flowering Peach. Beautiful while in flower.
Aralia sieboldii	8	Poor	Grand deep-green shining foliage.
Aralia papyrifera	8	Poor	Verv large dull-green leaves.
Ardisia crenulata	3	White	Small shrub, bearing a profusion of scarlet berries.
Aucuba japonica	6	Green	Good, hardy foliage shrub, especially the several variegated or yellow-blotched varieties.

Azalea indica (Figs. 39, 69, 84)	6	White, red, scarlet and flaked	Most profuse and showy flowerers. Many varieties, single and double. Hardy, evergreen shrubs; enjoy rockery, but like also abundant rainfall.
Azalea mollis	3	Yellow or red	Deciduous, very free flowering; well worth growing.
Beaumontia grandiflora...	5	White	A grand subtropical bush or straggler, bearing profusely its large lily-like flowers, and with large, ornamental foliage.
Bixa, several species		Pink or purple	Subtropical trees or shrubs.
Bouvardia, several species	5	White, pink, red, scarlet, or flaked	Profuse flowerers, very showy, and first-rate for cut flowers.
Brugmansia Knightii	10	White	The Moonflower. Sweetly scented, very large white flowers. Single or double. Half-hardy.
Brunfelsia, several species	5	White or purple	Neat, free-flowering half-hardy shrubs.
Buddleya Madagascariensis	10	Yellow	Straggling shrub, sometimes used for hedging. Foliage nearly white. Flowers in long showy spikes. A Zululand species is equally pretty.
Buddleya Lindleyana	6	Purple	A free-flowering, ornamental bush.
Calliandra Tweedii...	8	Scarlet	Pretty leguminous shrub, with scarlet stamens.
Callistemon, several species	20	Yellow, scarlet, white	Bottle-brushes. Rigid shrubs, flowering usually on the old wood.

Name.	Height in feet.	Colour of flower.	Remarks.
Calpurnia, several species	10	Yellow	Free-flowering leguminous shrubs.
Camellia japonica, many varieties ... ... (Figs. 43, 84)	15	White, pink, scarlet, streaked	Single and double. Well-known free-flowering shrubs. Do best in shaded, cool, forest localities.
Camellia thea. ... ... (Fig. 39)	10	White	The Tea-shrub. An ornamental evergreen shrub, which makes a pretty hedge.
Carissa grandiflora	6	White	Amatungula. Pretty white flowers and purple fruits, both freely produced. Does best coast-ward.
Cestrum laevigatum	10	Yellowish	"Inkberry." Often used for a hedge.
Colutea arborescens	6	Yellow	A free-flowering leguminous shrub, known as "Bladder-senna."
Coprosma lucida	6	Greenish	A neat, dense shrub, with dark-green evergreen shining foliage.
Cotoneaster Simmondsii	6	White	A compact shrub or hedge shrub; old leaves take autumn-tints, and berries are scarlet.
Cotoneaster microphylla	4	White	A dense little prostrate shrub, with small shining leaves; good for covering rough stone walls.
Crataegus oxycantha fl. pl.	10	White, pink, scarlet	"Hawthorn." Several pretty, double flowering varieties have been introduced. These require propagation by grafting or budding on common Hawthorn. Rather subject to scale.
Cyphomandra betacea	10	—	"Tree Tomato." Produces its red fruits in abundance. Damaged by frost.

Cydonia japonica	5	Red	"Japan Quince." A hardy, deciduous shrub, flowering freely while leafless or nearly so, during early spring.
Croton (including Codiæum), many varieties			Beautiful sub-tropical shrubs, with highly-coloured variegations and in some cases curiously malformed leaves.
Cytisus, several species	3	Yellow	Very free-flowering leguminous shrubs.
Daphne indica	6	White, pink	Sweetly scented flowers; pretty bush.
Datura Knightii			Brugmansia Knightii, Moonflower.
Deutzia crenata	5	Pinkish white	"Bridal Wreath." Very free-flowering and ornamental, especially the double varieties.
Deutzia gracilis	2	White	Very free-flowering and pretty.
Duranta Ellisii, alba	15	White	Free-flowering and showy, hardy shrub or small tree.
Duranta Plumieri	15	Blue	Free-flowering and showy, hardy shrub or small tree.
Ehretia acuminata	6	White	A pretty flowering hardy shrub.
Erythrina crus-galli	6	Scarlet	"Coral tree." Produces freely its gorgeous panicles of flowers.
Erythrina acanthocarpa	3	Yellow	Prickly, free-flowering, and showy.
Escallonia floribunda	6	White or pink	Pretty bush, hardy and floriferous.

Name.	Height in feet.	Colour of flower.	Remarks.
Eugenia Braziliensis	10	White	Evergreen shrub, producing the crimson Brazilian cherries.
Eugenia eucalyptoides	15	White	"Mimi." An ornamental evergreen shrub or small tree, with shining foliage.
Euonymus latifolius ... ... / Euonymus japonicus	6	Small	Very ornamental foliage shrubs, especially the various yellow and white-variegated varieties.
Euphorbia jacquiniflora	6	Scarlet	Produces spreading twigs, set with scarlet flowers.
Euphorbia splendens	4	Scarlet	"Christ's Thorn." A beautiful little edging shrub, very free-flowering.
Fabricia lævigata	10	White	Pretty grey-foliaged shrub, with drooping branches.
Ficus Parcelli	20	A Fig	Leaves blotched with white, giving an effectively variegated half-hardy tree.
Ficus repens	—	A Fig	Adheres closely to brick walls. Has small green foliage while doing so; afterwards it sometimes produces strong growth and large leaves.
Ficus elastica variegata...	50	A Fig	A beautiful variegation while young; loses its effect in larger trees.
Franciscea, several species	10	Purple, white	Pretty subtropical shrubs.
Fuchsia Rickartonii	5	Purple	A very ornamental hardy shrub.

Fuchsia, many varieties	5	Various	Require shelter from wind and a reasonably moist atmosphere.
Gardenia florida	6	White	Sweetly-scented double white flowers, very useful in bouquets, but rather overpowering; shrub hardy. free-flowering, and ornamental, but slow-growing. Usually grafted.
Gardenia globosa	10	White	Sweetly scented, very free-flowering, cultivates easily, and well worth cultivation.
Galphimia nitida	5	Yellow	Free-flowering subtropical shrub.
Genista scoparia	4	Yellow	"Broom." Very floriferous and showy.
Grevillea Caleyi	10	Scarlet	Small tree with vivid flowers.
Habrothamnus aurantiacus	6	Yellow	Free-flowering, hardy shrub.
Habrothamnus cyaneus	6	Blue	Free-flowering, hardy shrub.
Habrothamnus elegans	6	Scarlet	Free-flowering, hardy shrub.
Hakea, several species	10	White	Hedge shrubs.
Hamelia chrysantha	6	Yellow	Flowering shrub.
Hibiscus syriacus	10	White, pink, purple, etc.	Upright, rather rigid shrubs flowering along the stem; single and double.
Hibiscus sinensis...	10	Several shades of scarlet	Most profuse flowerers; bushes open; flowers large and gaudy.

Name.	Height in feet.	Colour of flower.	Remarks.
Hibiscus schizopetalus	10	Ditto.	Similar to above, but petals laciniated.
Hibiscus, many varieties	10	Various	Mostly showy, and worth cultivation.
Holmskioldia sanguinea	5	Scarlet	Ornamental shrub.
Hydrangea hortensis	5	Pink, white, blue	Common Hydrangea. Very floriferous, the colour of the flower affected by the soil.
Hydrangea paniculata	10	White.	Scarce shrub, with very large panicles.
Ixora, many species	5	Red, white, yellow.	Free-flowering and pretty shrubs.
Jasminum revolutum	7	Yellow	Free-flowering and pretty shrubs.
Jasminum, many species	—	White	Shrubs or partly creepers, chaste and scented; great favourites.
Jatropha multifida	2	Scarlet	Sub-shrub. Colour very vivid.
Justica, several species	—	Purple, blue, etc.	Small shrubs, or scandent; free-flowering.
Kerria japonica	4	Yellow	Flower like a small yellow rose.
Kerria japonica variegata	4	Yellow	Leaves variegated with white.
Lagerstroemia Indica	10	White, pink, purple, etc.	"Pride of India." Exceedingly floriferous and showy. Hardy.
Lagerstroemia reginae	10	Red	Subtropical. Flowers very fine.

Lasiandra macrantha	6	Purple	Foliage good. Flowers very deep colour. Half-hardy.
Leucadendron argenteum	20	Cone	"Silver Tree." Foliage silvery white.
Ligustrum japonicum	6	White	"Privet." Good foliage and hedge shrub. Several variegations, with yellow and white, exist.
Ligustrum lucidum	20	White	Larger. Flower more conspicuous, and foliage more robust. Propagates from seed only.
Lonicera caprifolium	—	White, yellow, etc.	"Honeysuckle." Sweet scented and free-flowering climber or shrub. Flowers of several colours.
Mackaya Bella	10	Blue	Pretty native shrub.
Magnolia, several species	—	——	Shrubs or small trees. Flowers of several colours, white, pink, purple, brown, etc.
Melaleuca, several species	25	Purple, red, white, pink, yellow	Small leaved shrubs or small trees. Often myrtle-like and suitable for saline soil round tidal lagoons.
Medinilla magnifica	6	Purplish	Large, ornamental leaves, and a most superb object while in good flower.
Meyenia erecta	4	White, blue	Free-flowering shrub.
Murraya exotica	10	White	Chaste flowers on good foliage.
Musaenda frondosa	6	Yellow bracts.	Pretty shrubs.

Name.	Height in feet.	Colour of flower.	Remarks.
Musaenda erythrophylla	6	Scarlet	Pretty shrubs.
Myrtus communis	6	White	Common "Myrtle." Scented foliage, useful for bouquets; pretty shrub.
Nandina domestica	3	White	Rigid, somewhat fern-like foliage, from an upright stem. Spikes terminal.
Nerium oleander	15	White, pink, yellow and streaked	The "Oleander." Profuse flowerer, in several colours; single and double. Juices poisonous. There is a variety with leaves variegated, with yellow streaks.
Panax, several species	—	——	Fine foliaged, half-hardy shrubs.
Pavetta, several species	5—20	White	Native shrubs or trees, known as "Christmas Trees" as the white flowers are freely produced at that season.
Peach, double flowered (see Amygdalus persica).		——	
Pentas carnea	5	Red	Free-flowering, half-hardy shrub.
Petraea volubilis (climbing)		Violet	Very pretty when in flower.
Philadelphus, several species...	10	White	Chaste flowers, like orange blossom, very freely produced in spring.
Pittosporum tobira	10	White	Flowers scented. A variegated-leaved variety is a highly ornamental shrub.
Plumbago capensis	10	Light blue	A straggling native shrub. Flowers of distinct colour, and abundantly produced. A white variety is also good.

Poinciana aurea	10	Yellow	A very pretty sub-tropical shrub.
Poinsettia pulcherrima	10	Scarlet bracts	Produces in autumn a gorgeous flower-like display of scarlet bracts, terminating each branch. Sub-tropical, and does best if cut hard back annually after flowering.
Portulacaria Afra	10	Pink	"Spek-boom." A native shrub, but both foliage and flowers are good.
Prunus pissardii...	10	White	Dark copper foliage, giving colour effect in garden landscape.
Prunus cerasus fl. pl.	10	White	Double-flowered white cherry. Very effective while in flower.
Punica granatum	10	Scarlet	The "Pomegranate." The double-flowered variety is highly ornamental. Varieties exist with white and yellow flowers, but the scarlet is the best.
Raphiolepis indica	5	White	Pretty bush; very free-flowering.
Rhododendron, many species	5	Various	Produce large trusses of flowers of vivid colours. Do well only in cool, moist situations, as in the Town Bush Valley.
Rondeletia speciosa	5	Scarlet	Beautiful evergreen, half-hardy shrub.
Roses		White	These constitute the essential shrubbery of every garden. The variety in colour, nature, habit, treatment, and behaviour is enormous and quite enough to fill a volume by itself.

Name.	Height in feet.	Colour of flower.	Remarks.
Sambucus	15	White.	Several variegated forms are distinct and ornamental foliage shrubs.
Spartium junceum	10	White, yellow	"Spanish broom." Nearly leafless shrub, flowering freely on green twigs.
Spiraea prunifolia	10	White	"Cape May." Free-flowering and ornamental shrub, especially the double-flowered variety.
Syringa vulgaris...	15	White, pink, purple, etc.	'Lilac," of European gardens. Often imported, but not always successful. Requires cool, moist, mountain localities.
Tabernæmontana coriaria	10	White	Chaste, white flowers.
Tecoma stans	20	Yellow	Small tree, Flowers, bright yellow, freely produced.
Thivetia neriifolia	10	Yellow	Handsome bush, with large yellow flowers.
Uhdea bipinnatifida	6	White	Half-woody shrub. Flowers freely.
Ulex europea	4	Yellow	"Gorse." Requires cool, high locality.
Veronica Hendersoni	4	Blue	A variety has beautifully variegated foliage.
Viburnum opulus	10	White	"Snow-ball Bush." Requires moist, cool locality; not always successful.
Viburnum tinus	5	White	'Lauristinus." Does best in cool, moist localities. An evergreen shrub.
Virgilia capensis	20	Lilac; purplish	Sweetly-scented flowers; ornamental, free-flowering small tree.
Weigelia, several species	5	White; rose; etc.	Free-flowering shrubs; highly ornamental when in flower. Usually deciduous. There are several good variegated forms.

Several more or less grotesque plants also impart a distinct character to garden or park vegetation, and are worth a place, where there is space, on that account. Among these may be mentioned:—

AGAVE AMERICANA.—*American Aloe.* Has long, rigid, pointed leaves in a rosette on the ground, and a flowering stem 20 or more feet high, from which, after flowering, light portable ladders are formed.

AGAVE AMERICANA VARIEGATA.—Highly ornamental, and worth a place in every garden.

AGAVE SISALANA (FOURCROYA SISALANA).—*Sisal Hemp.* A somewhat similar but less rigid species than A. americana. Formerly planted to some extent near Port Shepstone and near Greenwood Park, with a view to creating an industry in its fibre. It has grown reasonably, considering the ground given, but the industry has not yet caught on. It propagates easily from buds produced on the flowering stem.

AGAVE.—Several other species are well worth cultivation for variety.

ALOE DICHOTOMA.—(Fig. 81.) Grows to 25 feet in height, branching repeatedly. Grotesque, yet graceful. Propagates by cuttings.

ALOE SOCATRINA.—(Fig. 69.) Unbranched; a rigid, erect stem of 5—10 feet height, with succulent rigid leaves.

Several other indigenous species of Aloe have characteristic habit, together, in some cases, with conspicuous and attractive red flowers.

ANANAS.—(Fig. 76.) Several plants related to the Pineapple, and resembling it, more or less in habit, though without esculent "pines," are sufficiently distinct from ordinary vegetation to be worth a place. Among these some Tillandsias and other Bromeliads have highly coloured floral bracts.

CACTUS, CEREUS (Fig. 43) and OPUNTIA, have weird and often arborescent succulent leafless stems, combined in many cases with enormous evanescent flowers, some of which are highly scented, some night-flowering, and most species either yellow or highly coloured. Some have erect habit, others are scandent ramblers, some are pendulous, and some of the Opuntias (Prickly Pears) have caused much trouble through their tendency to become dominating weeds in hot, dry, rocky localities, and have only been held in check at considerable cost in Cape Colony and elsewhere.

CARICA PAPAYA.—*The Papaw,* has foliage and habit which produce a subtropical effect in any garden in the coastward districts, in addition to its fruit-bearing qualities.

CYCAS (Fig. 87) ENCEPHALARTOS, ZAMIA, and MACROZAMIA form a natural group having single erect stems and habit not unlike a tree-fern, but usually with rigid and often

spine-edged pinnate leaves, and bearing central cones like gigantic pineapples. They are slow of growth, but permanent in their foliage effect when once thoroughly established. Several species of Encephalartos are indigenous, and are quite as effective as any of the exotic.

DRACÆNA and CORDYLINIA have also erect single stems, usually slender, and surmounted by a plume of undivided and sometimes more or less grassy leaves, green in the original species, but often highly coloured in the varieties produced under horticulture. Some are quite hardy, others, including the highly coloured ones, are more or less sub-tropical in their requirements.

CORDYLINE AUSTRALIS runs up to about ten feet in height in as many years, and sometimes produces side stems from the base.

EUPHORBIA includes plants of exceedingly varied habit, including some arborescent and nearly leafless branched succulents (Fig. 76). Several of this habit are indigenous, but are well worth a place where the quaint and the curious are favoured, as well as the more ordinary types.

RAVENALLA MADAGASCARIENSIS (Fig. 76), STRELITZIA ANGUSTA (Fig. 90), and MUSA PARADISAE, are all in habit like Bananas on a larger scale. The effect of the introduction of an occasional clump of either among shrubbery is highly effective, but all are rather sub-tropical in their requirements.

RICINUS COMMUNIS.—*The Castor Oil Plant* (Fig. 87) has a very effective tropical foliage, which in one variety is enhanced by having brown colour, the fruits also being even more highly coloured.

YUCCA ALOEFOLIA VARIEGATA is a beautiful variegated form of the well-known species, and well worth a place in any collection. Most of the Yuccas have large panicles of chaste white lily-like flowers, often more or less scented, and foliage and flowers are alike ornamental. Yucca filamentosa has the margin of the leaf fringed with attractive loose ends of white thread-like tissue, and several other species have similar threads, or are otherwise variegated.

PALMS.—A very large number of species, belonging to many genera are fit for cultivation in Natal, about 60 species being already in growth in the Durban Botanic Garden. The habit varies immensely from the fan palms (Fig. 90), like the Livistona, Chamærops, Latania, Sabal, and the indigenous Hyphæne crinita (Ilala), to the graceful pinnate foliage of the Phoenix (Figs. 54, 82, 92), Cocos (Figs. 53, 54), Oreodoxa (Fig. 93), Areca, Seaforthia, etc., and the curiously cut leaves of Caryota.

COCOA-NUTS (COCOS NUCIFERA) thrive in Durban and along the coast, and are being planted in some quantity at the Empangeni Plantation; and the *Date Palm* thrives in more inland localities, improved varieties being meantime on order

from Egypt. The Palms vary considerably as to temperature requirements, but only a few species are hardy enough for exposed treatment in the upper parts of the Colony.

Many CREEPERS of more or less woody nature enter largely into the ornamentation of gardens, verandahs, and trellis-work, advantage being taken of plants which would get more or less straggling and unshapely shrubs unless provided with support, but which lend themselves well to this class of treatment. Among others may be mentioned:—

AMPELOPSIS QUINQUEFOLIA.—*Virginian Creeper.* A slender but rather rough creeper, whose chief beauty lies in the high autumn tints it assumes before the leaves fall in autumn. Leaves of five leaflets.

AMPELOPSIS VEITCHII.—*Japanese Ivy.* Adheres closely to brick walls, each leaf overlapping that below it. Very neat and ornamental at all seasons, but especially while the leaves have high colour before falling. Leaves undivided.

ARISTOLOCHIA.—Many species, known as *Dutchman's Pipe,* from the curious flower formation, have vigorous habit, large leaves, and usually a more curious than pretty flower.

BAUHINIA VAHLII.—This species in the Durban Botanic Garden gives an enormous growth, overtopping tall trees and producing fine foliage. A most vigorous Monkey-rope.

BEAUMONTIA GRANDIFLORA.—A straggling and half-climbing subtropical creeper, with fine foliage, and a grand display of large white flowers. Good for covering an earth-bank.

BIGNONIA CAPREOLATA.—A vigorous creeper, producing scarlet flowers, which show to best advantage pendant from verandah or trellis.

BIGNONIA (TECOMA) RADICANS.—A rampant climber, with large brick-red tubular flowers.

BIGNONIA (TECOMA) GRANDIFOLIA.—Hardy. An improved form of B. radicans.

BIGNONIA GRACILIS.—A slender plant, with pretty yellow flowers.

BIGNONIA JASMINOIDES.—Hardy. A vigorous grower, and profuse flowerer, the flowers being large, white, with a purplish throat, and very pretty.

BIGNONIA PICTA.—Slender growth. Flowers mauve streaked with white.

BIGNONIA VENUSTA.—*Golden Shower, Trumpet Climber.* A slender but vigorous creeper, producing a grand display of orange-red flowers in early spring.

BIGNONIA.—Many other species, in various colours, are well worth cultivation, being among the most graceful and pretty flowering climbers suited to this climate.

BOUGAINVILLEA.—Several species. Robust trailers, forming vigorous hedges, arbors, arches, or verandah and gable climbers, and producing a grand display of panicles of flowers, which consist of three coloured bracts each, surrounding the small and inconspicuous flowers. Varieties include Purple,

Magenta, Mauve, Brick-red, and other colours. The stems are thorny, and should be handled carefully, as the minute hairs on the thorns have a lasting irritating effect.

BUDDLEYA MADAGASCARIENSIS.—Vigorous, and free flowering. Flowers yellow.

CISSUS DISCOLOR.—Slender, the heart-sheaped leaves beautifully coloured.

CLERODENDRON.—Several species. Vigorous, subtropical climbers, producing panicles of flowers having scarlet corolla within a white calyx. Very pretty.

COBÆA SCANDENS.—A vigorous climber, having large purple bell-shaped flowers.

CRYPTOSTEGIA MADAGASCARIENSIS.—A robust subtropical climber, with large purplish flowers like Dipladenia.

FICUS REPENS.—Adheres to brickwork as a small-leaved Ivy. Vigorous shoots appear altogether different.

HOLMSKIOLDIA SANGUINEA.—Shrub or trailer. Flowers abundant, scarlet.

JASMINUM.—Several species. Slender twiners, with sweetly-scented white flowers, Single and double.

LONICERA.—Several species. *Honeysuckle.* White, yellow, or red. Good climbers, free flowering, and sweetly scented.

MANDEVILLEA SUAVOLENS.—Very free-flowering climber, producing chaste pure white flowers.

PASSIFLORA.—Several species. *Passion-flowers.* Vigorous creepers, including the *Grenadilla.* Flowers vary in colour with species.

PERESKEA ACULEATA.—*Barbadoes Gooseberry.* Used mostly as a hedge.

PETRAEA VOLUBILIS.—A slender but ornamental creeper, with abundant violet flowers.

PLUMBAGO CAPENSIS.—A shrub or creeper. Flowers numerous, light blue.

PRAINEA.—A slender but very free flowering shrub or creeper. Flowers violet.

ROSES.—These are the greatest favourites of all verandah creepers. Vigorous growers, like the MacCartney, Banksian and Crimson Cluster, may be trained up trees, gables, arbours, etc., but many others of the finer kinds, and in variety of colour, have sufficient vigour to allow them to be usefully employed on verandahs. All budded kinds require to be watched that the stock does not outgrow the bud.

RHYNCHOSPERMUM JASMINOIDES.—*Crape Flower.* Flowers profusely. Flowers small, white, sweetly scented, and very pretty. A slender creeper.

SOLANUM WENDLANDII.—A robust creeper, producing grand trusses of large mauve flowers. A constant flowerer.

STEPHANOTIS FLORIBUNDA.—A subtropical climber, with sweetly scented waxy white flowers.

TAXONIA.—Similar to Passiflora. Includes several red-flowered varieties.

TECOMA AUSTRALIS.—Vigorous and freeflowering. Flowers greenish, rather poor, but habit and foliage good.

TECOMA CAPENSIS.—Shrub or creeper. Flowers red, very showy.

TECOMA RICASOLIANA (T. MACKENII).—Shrub or creeper. Flowers numerous, large, purplish-pink. Very handsome.

WISTARIA SINENSIS.—The sweetly scented pendulous spikes of blue flowers of Wistaria are produced in profusion. Suits verandah or trellis, but the scent is overpowering to some people, and kills bees or other insects visiting the flowers. There is also a white Wistaria.

Trees adapted for planting in public streets are much less numerous than those fit for ornamental purposes. This arises from several causes. What are wanted are spreading, shady trees of medium height, sufficiently dense in canopy to afford shade to foot passengers, and yet not so dense as to interfere with light or air for neighbouring houses or gardens.

Tall trees usually have their foliage so high as to be but imperfect canopy, while there is also danger of such trees being broken or thrown by wind, and doing damage in the downfall.

Columnar trees, like the upright Cypress, Callitris rhomboidea, or Lombardy Poplar, are absolutely useless, as they cast no shadow when the sun is overhead. Small bushy trees are apt to have their branches too low and to interfere with pedestrians and traffic; deciduous trees are objectionable, since they shed their leaves into the guttering, and are apt to choke it, besides making an untidy litter below them; while trees, accustomed to sucker, like the Poplar, the Blackwood, and the Pear, lose part of their value through this tendency to wander on to other people's property, and so prove themselves nuisances.

Trees whose roots upset the pavement, like the Belhambra and the Kaffir-boom, are also objectionable, and so are trees whose thorns come in contact with the public at any stage. Fruit trees, like the Pear, Apple, Apricot, Mulberry, Guava, Plum, etc., which, in themselves, have qualifications, become objectionable through the attractions held out to children when a crop, or even a few fruits, are produced, and it seems desirable to avoid these in any street plantings scheme, though they are in common use in the Karoo towns of Cape Colony.

From these causes the list of available trees is very much reduced, and where a street is sufficiently drained for sanitary purposes and public convenience, there is always a danger that the trees may suffer from drought and absence of root aeration, as has happened recently with the Oaks in front of the Standard Bank, Church Street, Pietermaritzburg. Kinds require to be selected in accordance with the site in which each is to be planted; some streets are cut so far into the hard subsoil that any endeavour at treeplanting is money

wasted. Efficient protection is necessary for every young tree, and should be maintained so long as the tree is in danger from either traffic, stock, or boys' mischief.

Trees are better left out from busy business streets; in any case the trees should be on the street itself, not on the pavement. Branches of young trees should be pruned off to an extent sufficient to avoid annoyance to pedestrians, and eventually produce clean stems to above traffic height; branches of old trees should be lopped off to a sufficient height to allow street traffic and pavement traffic to proceed without brushing, even during wet weather. Kinds which naturally go high can often be kept in check by removing the leader while young, and preventing another leader from taking its place, and this should be done frequently upon young leaders rather than occasionally after the operation means removing half the tree each time.

In Durban the natural tendency towards flat tops in most species, and the unsuitability of Eucalyptus to the locality, have evolved a better class of street trees than is used in most inland towns where Eucalypts thrive, and where coast wind effect is absent.

In Durban the two species of Ficus, known as *Uluzi* (Fig. 87) and *Mpai* (Fig. 89), the well-known *Umlolwa*, Hibiscus tiliaceus (Fig. 85), and the *Flamboyant*, Poinciana regia (Figs. 52, 55, 90), are almost the only trees used; all are suitable, but the list is open for enormous extension. In the inland towns no systematic street planting has been done until recent years, so the results with kinds used can, meantime, only be watched as they evolve, taking care to keep on correct lines so far as possible.

CHAPTER XXIII.

HEDGES AND SHELTER-BELTS.

The privacy as well as the comfort of any house or estate depends as much on its hedges and shelter-belts, as on any other detail of its design and laying out. A hedge may impart to a place a neat, tidy, well-cared-for appearance, or may mark it out as the home of negligence, or of fitful attention. Usually the hedges reflect the character of the owner, and exhibits him at a glance even to the casual tramp. In their lowest forms it is difficult to say where edges end and hedges begin. Thus the *Christ's Thorn*, Euphorbia splendens (Fig. 76), when only a foot high is a most beautiful edge plant, flowering profusely, and fit to take a place here in what is known as carpet bedding in Europe, and still the same plant grown on to 3 feet in height makes rather a formidable thorny hedge close enough to keep cats from crawling through. In this stage also it flowers freely. Again, the little Juniper is often set from divided plants as an edge for a flower bed, and kept at that for several years, though quite suitable for growing into a 3 foot hedge.

The *Arborvitae*, Thuya orientalis, is usually planted as little seedlings six inches apart, and kept as a dwarf hedge one to three feet in height, forming one of the most compact and ornamental hedges obtainable in this Colony, though rather slow-growing, but if allowed to go on untrimmed it eventually goes on to a height of twenty feet, and is then rather open and straggling.

English Box, Buxus sempervirens, is planted when only three inches high, and kept pruned into form, but eventually gets to several feet in height, though it is sometimes destroyed by Dorthesia before it reaches that size.

Good hedges can be made of almost any species of Cupressus by planting close—say, 9 to 12 inches apart—and keeping the plants always pruned into form. Cupressus macrocarpa and Cupressus lusitanica are much used in this way in the Transvaal and Orange River Colony, though the former, being a climatic exotic, has a tendency to show gaps through occasional plants dying out. Both species are fairly safe here on reasonably deep ground, making hedges of any height up to 10 feet, but they require regular attention, as they rather resent being cut back hard after a lengthened period of undue liberty.

Cupressus Lawsoniana, where it does well, makes a remarkably pretty hedge, and so does C. funebris; both have

very distinct habit, which shows better when unpruned than in a closely dressed fence.

CUPRESSUS PYRAMIDALIS (Fig. 31, 78), having a close, upright habit, is sometimes used, planted closely, for forming a high narrow fence, the lateral expansion being very little; such a fence is useful in an orchard where high shelter is desired without undue branch development.

CALLITRIS RHOMBOIDEA.—*Oyster Bay Pine*, and other species of Callitris make, with sufficient care, nice, compact hedges of 3 to 6 feet, but it is apt to run wild if not regularly trimmed, and has also a defect in that single trees die out after full size is attained, leaving a gap difficult to fill.

The Berg Cypress and the Mlanji Cedar, when obtainable in quantity, will probably both be found most useful hedge plants.

JUNIPERUS VIRGINIANA (Fig. 30, 70) and J. BERMUDIANA (Fig. 41) both make very neat dressed hedges; the former has the qualification of doing better on rocky soil than other trees, while the latter does well on the coast.

There are several shrubs with small roundish leaves, or lanceolate leaves, which, on suitable soil, make very neat fences if sufficiently trimmed, but which are rough and untidy if left to nature. Among these are:—

MYRTUS COMMUNIS.—*Myrtle*, which, for a dressed hedge of 2 to 3 feet height, is difficult to beat. It requires, however, a fair amount of moisture, and is sometimes subject to scale.

EUGENIA BRAZILIENSIS.—*Brazilian Cherry*. Forms a very neat hedge in the coast districts, and has a pretty red tinge when new growth is coming on.

CAMELLIA THEA.—*The Tea Plant* (Fig. 39). In coastward localities, or in the mist-belts where clear of frost, trims into a neat and compact dark-green evergreen hedge, in which the white flowers are freely produced, and show to advantage.

PUNICA GRANATUM.—*The Pomegranate*. Is very neat when well trimmed, though usually seen as a rough untrimmed mixture of fruit tree and hedge. It is, however, almost deciduous in some places.

LIGUSTRUM JAPONICUM, *Japanese Privet*, is a very suitable hedge where water can be supplied, or moisture is naturally present. It is apt, however, to die off in patches if subjected to natural drought, or to become deciduous in patches even if these do not die, and thereby to lose its regularity and beauty. It is easily raised from cuttings set in autumn. In high, cold districts it is almost deciduous, in more favourable localities it is quite evergreen.

LIGUSTRUM LUCIDUM, *Chinese Privet*, is a larger tree, with larger and more distinctly evergreen foliage. It flowers freely, and is therefore often grown to be a tree, but as a large hedge it is equal to, or better than, L. japonicum, especially in high districts, where it is quite hardy, and does not lose its foliage in winter. It does not propagate easily from cuttings, but grows from seed.

COTONEASTER SIMMONDSII makes a neat little hedge, with the additional attraction of bright scarlet berries.

SPIRAEA PRUNIFOLIA, *Cape May*, makes a compact little hedge, and as the white flowers show themselves even in a pruned hedge, they produce a nice effect, especially the double-flowered variety.

CARISSA GRANDIFLORA, the *Amatungula*, is one of the best hedges in the lower districts, but is not hardy enough for up-country. Its vicious forked spines make it a safe fence when once far enough up to protect itself. It stands clipping, but is often grown untrimmed for the sake of its pretty white flowers and purple fruit, the latter being used for preserves.

PORTULACARIA AFRA, *Spekboom*, is a succulent indigenous shrub, which makes a neat and formal dressed hedge up to about three feet height. Beyond that size it is too easily broken to keep form well.

ABERIA CAFFRA, *Kei Apple*, is a thorny, dioecious, indigenous shrub or small tree, which makes an impenetrable fence if trimmed regularly from youth onward. Sometimes to assist a young hedge to gain strength its shoots are allowed to grow for a season, and then bent down and intertwined, fresh thorny twigs coming from all along these next season, and pruned several times during the year. This hedge is a great favourite in Kaffraria, but has not been so well received here. The fruit is like an apricot, and used for flavouring preserves.

ACACIA LONGIFOLIA, a free-flowering shrub, which clips into a neat fence, but, being short lived, is apt to die out as single plants, leaving gaps which cannot be filled, when only 10 or 12 years old.

PERESKEA ACULEATA, *Barbadoes Gooseberry*. A thorny rambler, which, on a wire fence, trains quickly into a good hedge, but is hardly strong enough to be self-supporting.

TECOMA CAPENSIS.—An indigenous shrub, inclined to become lanky, but responds well to frequent clipping. Grows from cuttings, and when young produces its red flowers in abundance.

PLUMBAGO CAPENSIS.—An indigenous blue-flowering shrub of loose habit, which, however, can be clipped into shape.

HALLERIA ELLIPTICA, *Umbinza*, an indigenous tree, which makes a very neat evergreen fence if regularly pruned while young.

CESTRUM LAEVIGATUM, *Ink-berry* (Fig. 87), a rough hedge-plant, which, however, makes a fairly neat hedge by close attention.

PINUS HALEPENSIS, *Aleppo Pine*, grows slowly at first, but makes one of the prettiest and neatest hedges if regularly trimmed. It eventually becomes too large, but not necessarily for a long time.

PINUS PINASTER, *Cluster Pinë*, grows more rapidly at first than Aleppo Pine, sooner forms a hedge, though a rougher one, and sooner gets beyond that stage.

HAKEA LINEARIS, a vigorous and neat hedge in the mist-belts, requires frequent trimming.

Several other species of Hakea are used as hedges in the Cape and Transvaal, but have hardly been tried here yet.

FABRICIA LÆVIGATA (LEPTOSPERMUM LÆVIGATUM, *Australian Myrtle*, makes a very neat and vigorous grey-leaved hedge. If not pruned often it produces numerous slender flowering twigs, arching from the top of the hedge.

DOVYALIS RHAMNOIDES, *Zuurbesjes*, an indigenous half-hardy shrub, which makes a neat fence, and when allowed to grow on produces freely its acidulous scarlet fruits.

MACLURIA AURANTIACA, *Osage Orange*, makes an exceedingly strong, rough prickly fence, which can in no sense be considered an ornamental hedge.

CRATÆGUS OXYCANTHA, *English May, Hawthorn*, is not of the same use here as in England on account of its inability to stand satisfactorily the long dry winter and dry spring. It lives, but it cannot be recommended as a hedge plant.

So also *Holly* (Ilex aquifolium) and *Yew* (Taxus baccata), both of which live under special circumstances, but are not suitable for hedges here.

BAMBUSA FORTUNEI (Figs. 53, 81, 91).—This is without exception the most satisfactory hedge in the coastward portions of the Colony, extending also into the mist-belts. Easily raised from cuttings of the older stems, evergreen, neat, sufficiently vigorous to form a hedge early, and still not requiring an undue amount of attention, it meets all requirements where a wire fence is provided. It is not, however, stock-proof without that.

The above are only a few of the many plants available for hedge purposes, but they include some of the best. In almost all cases regular trimming is most important, as the gaps so often seen in fences are usually due to growth having been allowed to go on too far, and then been cut hard back to an extent the bush could not stand under the trying conditions of hedge culture.

There are many other plants in common use for rough hedges which seldom trim into nice form.

The *Quince* is one of these; it can be kept neat, but very seldom is so.

The *Osier* is also grown as a rough fence, but seldom kept in neat form.

BOUGAINVILLEA is sometimes used as a rough hedge-screen: it is thorny and impenetrable if planted closely, but loses much of its natural floral beauty if subjected to formal trimming.

EUCALYPTUS LEHMANNII forms a fairly neat strong hedge; even under regular trimming, but its tendency to assume tree-growth, and to become bare below, always asserts itself if opportunity is allowed.

MORUS ALBA, *Chinese Mulberry*, is often used as a screen, but serves that purpose better than as a formal hedge.

AZALEA INDICA makes a beautiful floral hedge in suitable situations if allowed to grow vigorously, and only kept in shape by the removal of unduly long twigs. It is not, however advisable to clip it into form, as the flower-buds are thereby removed.

Roses may also be used for hedge purposes, the *Sweet Briar*, *Rosa microphylla*, and the *Banksian Rose*, making fairly neat trimmed hedges without support, but most roses require, or are at least the better of an iron fence, as support and protection.

The Maccartney Rose, with its shining evergreen leaves and pretty white single buds, is one of the best hedge plants, but it is so prickly that it is apt to be pulled out of shape by everything which passes.

Many other shrubs, such as *Oleander*, Lagerstraema, Buddleya, Abelia, Deutzia, Duranta, Escallonia, Euonymus, Hibiscus, Philiadelphus, etc., are occasionally used for hedge purposes, but are usually allowed to grow too rough for coming within the category of neat hedges. These might rather be classed as rough hedge plants. A totally distinct class of hedge is that produced by Aloes, Agaves, Fourcroyas, Yuccas, etc., which, while they make more or less impenetrable fences, must be allowed to take their natural habit, and are difficult to repair if a gap does happen to occur, as inevitably happens as soon as the Agave and Fourcroya kinds begin to flower.

Prickly Pears, Opuntia, also are used sometimes for hedge purposes but they are irregular, ugly, dangerous, and always liable to become a nuisance.

For large hedges or shelters for deciduous orchards the various species of Cupressus are among the best, though many growers prefer the deciduous, upright *Lombardy Poplar*, Populus fastigiata, as giving shelter while it is required during the flowering and fruiting season, and yet allowing the wood of the fruit trees to be thoroughly ripened by exposure during winter. For orchards of evergreen trees evergreen hedges are, of course, preferable, and on the coast it is frequent practice to shelter with Plantains or *Amatungula*, the orchards in which the finer kinds are grown.

Shelter trees include all trees planted in the vicinity of a homestead, orchard, or paddock, and consequently include practically all trees. The distribution has, however, been the subject of these previous chapters, and does not require review here.

It may, however, be repeated that very often trees are planted so close to a homestead as to prevent ventilation, and almost invariably they cut off the best views. They are planted small, and so do not at that time show what they will grow into; they grow gradually, but as surely they secure places in the affections of the owners, and it usually comes to be a heart-wrench when a fine specimen has to come out to allow the view it should never have obscured.

At a sufficient distance, and in well-considered order, shelter trees have a most beneficial effect, especially in up-country districts, but as the circumstances of the case vary so must the kinds and the arrangement, so that general rules are hardly applicable. Mixed groups seldom do well; those that feed most grossly usually dominate over their less vigorous neighbours, and so Eucalypts and Wattles require to be kept in groups by themselves, while other kinds may be mixed if widely planted, or kept unmixed if closely planted. The Black Wattle is one of the best shelter-belt trees, if planted sparsely, so as to allow of abundant branching, but it must be remembered that both this and the Eucalypts drain the neighbourhood rather severely, and affect the growth of grass or crops for some distance. Toward the coast Melia is one of the most common shelters, not because of any inherent quality in that direction, so much as that it can be relied on to grow while other kinds can not. Many other kinds, however, come in useful there, including the *Wild Figs*, Cupressus, Juniperus, Bambusas, etc., etc.

CHAPTER XXIV.

HORTICULTURE.

The relation between horticulture and arboriculture is most intimate, but while the former includes the latter in many of its phases, it includes a great deal else. I do not propose, therefore, to enter on horticulture in its widest sense, but rather confine my remarks to the relationship between the two, and the effect of the one upon the other. Let anyone inspect a garden without a tree in sight, as can be seen sometimes in the Cape Karroo, or in the islands of Orkney and Shetland, and he recognises at once that he has met Nature in one of her wayward moods. It does not look happy; it looks incomplete. Even those highly artificial gardens in which carpet-bedding takes the place of Nature, show that the segregation of highly coloured foliage or flower effects, however gaudy, brilliant, or pretty these may be, cannot equal the setting of Nature in which flower and foliage mix, where grass, shrub, and tree unite to produce a landscape rather than a chess-board, and where variety is in decided contrast to the uniformity of the other.

And in the potato, strawberry, or mealie garden, where esthetics disappear, and practical utility reigns supreme, the same striking contrast with Nature is evident; economic reasons may excuse the potato patch, but inherent beauty remains on Nature's side. It does not do, perhaps, to allow sentiment to carry one away entirely; the economic must be studied as well as the ornamental; but, after all, a happy combination of the two suits most natures best. There is thus given space enough for fine specimens to develop to best advantage, while at the same time the intervening space is more or less occupied in economic return. This happens where vegetable or even flower culture must of necessity help to earn a living for the owner or occupier of an erf, or save expenditure by supplying his own table. Something similar also happens where the lover of flowers occupies available space in gathering his favourites near him. In neither case, however, can it be said that both crops do their best. Trees almost invariably draw seriously on the resources of the soil around them, with the result that the smaller crop suffers unless manure and water are plentifully applied. Even with these there is danger, since both tend to bring the tree roots to the surface, where they may suffer severely if drought supervene during a time when the water is of necessity closed off, or the owner absent from home for a month. The trees thrive best

and grow fastest which receive the manure and the water; on the other hand, they suffer most easily. Trees which receive no such encouragement usually make slower but more thrifty growth, the roots wander far to forage for themselves, and in a dry time they still have one or more roots touching a moisture supply somewhere, and yielding sufficient to tide over the bad time.

It follows then that unless special attention can be kept up trees and shrubs which are not pampered stand the best chance of a long life.

On the other hand, the vegetable or flower crop is always apt to suffer from proximity with the active rootlets of trees, and beds often remain poor and unsatisfactory from the attentions of trees standing a long distance off. A healthy tree will send roots out to a distance equal at least to its own height, and very often a healthy Gum or Wattle will practically destroy all other vegetation within that distance.

Some plants naturally enjoy the shade, or even the humus, obtainable under forest cover, but these are comparatively few, and the vast majority prefers full light, if protected from wind by trees at a distance.

In the interests, then, alike of the trees and of the undercrop, it is advisable where practicable not to mix them up, but to give as wide a separation as can be, but still with a background or shelter of distant trees for the kitchen garden, with a few slow-growing specimens within it to relieve the monotony and produce effect.

Specimen trees show best grown in grass, if the shade is not too dense to allow the grass to be healthy; where that is the case it is often better to have a clear space under the tree, in which a fine surface, constituting a dust mulch, is always maintained. Grass naturally draws somewhat on the resources of the soil, but with many species of trees a grass under-mat is natural to them, and in reasonably open soil does them little damage, beyond producing rather slower growth. This, of course, does not apply to fruit trees, or such other artificial products as exist only in good form through artificial stimulus, and rapidly deteriorate where that is withheld.

The grass itself shows off the trees best when nicely kept; indeed, rough grass is seldom ornamental in horticulture, except in extensive woodland landscape, and even then it requires to be clear of rough tufts or weeds. Pretty grassland plants may, however, be introduced with advantage, simply scattered through the grass without regularity and without formality; a natural picture, and following as closely as may be the type set by Nature. In all the horticulture of Europe there is no prettier scene than the woodland gardens, where the imitation of Nature is studied as a fine art, where trees, shrubs, and herbs, exotic and indigenous, are interspersed in wild though studied profusion, and where the functions of the botanic garden overlap into those of Nature-study and Nature enjoyment.

This is a phase of horticulture still undeveloped in Natal, but in a Colony like this, where land and labour are of comparatively low value, where the creation of landscape effect is a most pleasing and responsive, and not uncommon, enjoyment, and where pretty grass-land flowers abound, though seldom in abundance and variety at one place, it is well worth cultivation, especially between Mooi River and the coast.

Apart from the production and satisfactory exhibition of fine specimen trees on suitable grounds, there is only one more matter worth mention as being not attempted here, viz., the formation of trimmed trees. These very unnatural and fantastic productions are curiosities rather than ornaments, and they require such persistent and regular attention during many years that they are never likely to become a hobby here. Still, in England, France, and Italy, trees trimmed into grotesque forms are quite a feature, while huge and highly trimmed hedges are not uncommon. The kinds in use there are mostly Yew (Taxus) and Holly (Ilex). Neither of these are fit subjects here, but we have others quite as suitable, including Juniperus Virginiana, Callitris rhomboidea, Cupressus pyramidalis, C. macrocarpa, Widdringtonia Whytei, Pinus halepensis, Cotoneaster microphylla, Yellowwood, and several other fine-leaved shrubs and trees.

I do not commend this form of abnormal monstrosity, but as there are occasionally situations where they come in useful, the above are mentioned as being the most suitable.

Height of Trees.—The following particulars with regard to the rates of growth of various specimen trees in the Natal Botanic Gardens, Durban, are taken from the Annual Report, 1902-1903, of that Garden, and may be considered a fair sample for the coast. Where no date is given the tree was certainly planted previous to the year 1882, and many of them long before that time.

Name of Tree.	Circumference of stem 4ft. up. ft.	in.	Height in Feet.	When Planted.
Acacia retinodes, Sch.	0	11	10	1894
Acacia saligna, Wend.	2	9	20	1894
Albizzia procera, Bth.	3	7	35	1885
Apodytes dimidiata, E.M.	2	1	30	?
Araucaria Bidwillii, H.K.	7	0	60	1867
Araucaria Cookii, R.Br.	6	10	104	1867
Araucaria Cunninghamii, Ait.	5	6	90	1867
Araucaria excelsa, R.Br.	3	9	80	1867
Auracaria Rulei, F. v. M....	2	3	36	1868
Artocarpus integrifolia, L.f.	4	0	50	?
Barringtonia acutangula, Gaertn.	3	0	25	?
Callitris robusta, R.Br.	1	0	17	1892
Callitris verrucosa, R.Br.	1	4	30	1892

Name of Tree.	Circumference of stem 4ft. up. ft.	in.	Height in Feet.	When Planted.
Calodendron capense. Th.	3	5	35	?
Calophyllum inophyllum, Linn....	1	0	25	?
Cassia fistula, Linn....	1	6	20	?
Cassia florida, Vahl.	3	8	60	1884
Cedrela odorata, Linn.	6	8	66	1869
Cedrela Toona, Roxb.	3	1	30	1886
Celtis Australis, Linn.	2	0	18	1894
Chaetachme aristata, Pl.	5	6	44	?
Cinnamomum camphora, Nees.	3	5	40	?
Cupressus funebris, Endl.	3	3	30	?
Cupressus sempervirens, Linn.	3	10	70	?
Cupressus torulosa, Don.	3	8	35	?
Lammara alba	3	3	75	?
Dammara australis, Lam.	5	0	80	?
Ehretia acuminata, Br.	1	10	15	1894
Ekebergia Meyeri, Pr.	3	9	35	?
Elæocarpus grandis, F. v. M.	3	1	40	?
Eriodendron anfractuosum, D.C.	3	0	25	?
Eucalyptus acmenioides, Sch.	3	4	52	?
Eucalyptus cornuta, Labill...	6	0	70	?
Eucalyptus leucoxylon, F. v. M.	5	6	80	?
Eucalyptus tereticornis, Sm.	5	10	80	?
Eucalyptus viminalis, Labill.	5	8	84	?
Excoecaria sebifera, F. v. M.	2	4	20	1894
Frenela australis, Hook...	5	3	40	?
Frenela rhomboidea, Endl.	1	0	20	1892
Grevillea robusta, A. Cunn.	8	10	70	?
Guiacum officinale, Linn.	0	11	15	?
Heretiera Fomes, B. and H.	——		5	1894
Heretiera macrophylla, Wall.	——		8	1894
Hymenaea courbaril, Linn....	3	6	66	1867
Jacaranda mimosaefolia, D. Don	5	6	40	1885
Juniperus Bermudiana, L.	6	0	53	?
Juniperus oblongata, Lond.	2	0	21	?
Juniperus virginiana, Linn.	3	10	40	?
Lagerstraemia regina, Roxb.	1	10	20	1892
Liquidamber styraciflua, L.	1	8	20	1894
Lysiloma sabicu, Bth.	——		18	1892
Macadamia ternifolia, F. v. M.	2	1	25	?
Mangifera indica, Linn.	4	6	56	?
Melaleuca genistifolia, Sm.	1	0	20	1894
Melia azadirachta, Linn.	1	5	20	1886
Millettia caffra, Meisn.	2	4	25	?

Name of Tree.	Circumference of stem 4ft. up. 4ft.	in.	Height in Feet.	When Planted.
Mimusops obovata, Sond.	4	0	30	?
Owenia acidula, F. v. M.	2	5	25	?
Phyllanthus emblica, Linn.	4	6	40	?
Pinus Benthamiana, Hort.	5	8	50	?
Pinus Halepensis, Ait.	3	3	30	?
Pinus Maritima, ?	4	0	25	?
Pinus palustris, Miller	2	3	25	?
Pinus Sinensis, Lam.	2	11	30	1887
Platymiscium polystachyum, Bth.	2	4	50	?
Podocarpus pungens, v. Houtte.	1	11	25	?
Podocarpus Thunbergii, Hook	1	0	12	?
Quercus incana, Roxb.	3	6	50	?
Santalum album, Linn....	4	0	35	?
Stenocarpus salignus, R.Br.	1	6	20	1885
Stenocarpus sinuatus, Endl.	1	8	25	1889
Sterculia acerifolia, Hems.	1	8	20	1894
Swietenia mahogani, Linn.	1	11	25	1887
Tamarindus indica, Linn.	4	0	57	?
Tectona Hamiltoniana, Wall.	1	6	25	1883
Terminalia arjuna, W. and A.	1	0	17	?
Terminalia catappa, Linn.	4	0	40	1884
Thuya gigantea, Nutt.	1	10	22	?
Toddalia lanceolata, Lam.	3	7	33	?
Tristania conferta, R.Br.	3	4	50	1883
Zizyphus mucronata, Willd.	7	3	40	?

Sir George Sutton favoured the Agricultural Department in 1902, with information concerning trees grown by him at Howick, from which the following are culled:—

Name of Tree.	Date of Planting,	Circumference of stem 4ft. up.	Height of Straight Stem.	Remarks.
Acacia melanoxylon	1875	3ft, to 4ft. 6in.	40ft. to 50ft.	Good sound wood, but grows slowly.
Cedrus deodara	1880	6ft.	30ft.	
Cedrus deodara	1880	4ft, 3in.	15ft.	
Alder (American)	...	1ft. 6in.	6ft. to 10ft.	Grows slowly.
Acer dasycarpum	1877	3ft. 9in.	15ft.	'White Maple." Grows well. Will not make timber in my time.
Acer saccharinum	...	...	...	Sugar Maple. Failed to grow.
Castanea vesca	1877	...	...	American Chestnut. Grows freely, but fruits very little.
Taxodium distichum	...	...	...	No value here.
Ulmus Americana	1877	2ft. 10in. to 3ft. 6in.	40ft. to 45ft.	Grows freely to handsome trees. Wants more water in winter than I can give them.
Eucalyptus corymbosa ...	1880	...	...	All killed by frost when six feet high.
Eucalyptus obtusifolia ...	...	4ft. to 4ft. 9in.	40ft. to 45ft,	Quick-growing, good trees.
Eucalyptus bicolor	1881	4ft. 3in. to 5ft. 6in,	40ft. to 60ft.	Very good growth.
Eucalyptus robusta	...	3ft. to 5ft. 6in.	60ft.	Not satisfactory.
Pinus insignis	1882	9ft. to 10ft 6in.	40ft.	Planted among gums and shaded by them. Have not died at the top.
Pinus canariensis	...	...	...	Not satisfactory.
Eucalyptus (Torr-vale) ...	...	2ft. 6in. to 3ft. 3in.	40ft. to 60ft.	Tall clean and straight.
Eucalyptus siderophloia..	...	3ft.	20ft.	Iron-bark. Does not do well with me; many died.
Eucalyptus amygdalina .	...	2ft. 9in to 3ft. 8in.	25ft.	Hardy and grows easily.
Eucalyptus obliqua	...	3ft. to 6ft.	50ft. to 70ft.	One of the hardiest and best.
Eucalyptus paniculata ...	1878	2ft. to 3ft.	25ft. to 35ft.	Grows very slowly, but very straight.
Eucalyptus tereticornis ..	...	3ft	25ft. to 35ft.	Grows fairly well. Too often dies from the top.
Pinus austriaca	...	...	...	Seed came up but trees did not grow.
Pinus corsica	...	...	...	Three feet in height in several years. Dug them up.
Larix	...	...	...	Died when three inches high.
Juniperus virginiana ...	...	...	...	Grows easily. Sows itself. Does not make much timber.

Name of Tree.	Date of Planting.	Circumference of stem 4ft. up.	Height of Straight Stem.	Remarks.
Carya olivæformis	1877	3ft 10in.	10ft.	Peccan Nut. Grows readily, fruits well. Will be long before it makes timber.
Carya alba	1877	1ft. 6in.	15ft. to 30ft.	Hickory. Has fruited for three years. Tall and straight.
Carya tomentosa	1877	1ft. 6in.	15ft. to 30ft.	Hickory, Thick Shell. Fruited this year.
Juglans cinerea...	1877	2ft to 3ft.	...	Butternut. Has fruited for long time. Do not make good stems.
Juglans nigra	1877	2ft, to 3ft,	...	Black Walnut. Has fruited for 10 or 12 years at least.

CHAPTER XXV.

DRIFT-SAND RECLAMATION WORK.

In few ways can man, by mere recklessness and subsequent neglect, start into operation forces more difficult to deal with than when he breaks the natural bush-barrier skirting the sea, and gives opportunity for the wind to start a sand-drift. Such sand-drifts, started within recent times, have in various parts of the world rapidly assumed vast and uncontrollable proportions, burying in sand whole villages and considerable districts, and have cost very large amounts to arrest. Generally speaking, the Natal coast rises to a sufficient elevation close to the sea to render this danger an unlikely one; but in Zululand there are vast flats occupying the whole space between the railway and the sea, from Umlalazi to Umfolozi, which would easily be converted into a huge sand-drift if the dunes were broken at any part. Before such a danger becomes more real by any breaking of the dunes which may be considered necessary in connection with the opening of the Umhlatuzi, or any similar scheme, it is well that a little warning has been given by Nature at so easily accessible a point as the Back Beach, Durban. The Durban Corporation, in its wisdom, intentionally broke the barrier about twenty years ago, carried West Street and Sea View Street through to the sea for the convenience of bathing and pleasure parties, and sold several erven where the natural bush should have been left. Fortunately, the sandy beach is narrow at this part, and the winds mostly off-sea at nearly a right angle to these streets, otherwise Durban would have known more about sand-drift years ago than it does to-day. But with the least possible opportunity of forming a sand-drift, something of that nature has formed, and several properties are seriously threatened by the inrush of a sand-hill filling both streets and the intervening space to a depth of twenty feet above the original street level. The present position is that the dune has been restored by nature nearly as it originally existed, but without the vegetation, and consequently without fixed tenure, and may at any time be blown bodily landward, while its even sloping face has formed an easy incline up which sand drifts only to topple over the top into the properties behind. Several years ago an endeavour was made to prevent the drift by the erection of an upright corrugated iron fence on the top of the newly-formed dune, but this only had the effect which might have been expected, of increasing the sand accumulation in front of the fence until an incline to its top was deposited, after which the

dune continued forming on the other side. During the late war the neighbouring wooded dunes formed the temporary camping ground for many up-country refugees, and the traffic raised by these kept the sand in a constant state of motion. The seriousness of the position forced itself upon the Corporation during the earlier months of 1903, and the matter was placed in charge of the Parks Committee, whose chairman—Hon. R. Jameson, M.L.C.—is an enthusiast in relation to it, and has already done a great deal towards meeting the trouble at the right end. For it must be noticed that the previous endeavour was made at the wrong end, *i.e.*, after the wind had gained hold upon the sand and was capable of raising it over any reasonable obstacle. The present works aim at fixing the sand as near to the shore as possible, and by vegetation restoring the stability of the dune, but, as has so often been found elsewhere, this is a work that can only be accomplished by patient perseverance, combined with skill, and these, fortunately, are being applied. It must be explained that the bush-clad dunes originally formed a crescent-shaped ridge from the Point northward, skirting an open rounded bay of the Indian Ocean a mile or more in length, beyond which the dune widens and has a rounded outline facing the sea until the mouth of the Umgeni is reached (Figs. 97, 98).

The sandy beach is scarcely one hundred yards wide at high water at any point, and even at low water no great surface is exposed. The broken barrier is near the middle of the crescent; from thence to the Point there are indications that the beach is increasing since the breakwater was built; while in the northerly direction the sandy beach extends of equal width for about half-a-mile, then tapers off until on the outward bend of the dunes the high-water is eating its way into the bush-clad dune. Between the sandy beach and the bush-clad dunes elevated knolls fixed with Scavæola, Ipomæa, and Cyperus occur almost continuously within about fifty yards of high-water mark, and prevent the wind ever gaining hold of the sand, that on the knolls being stationary though probably rising gradually in company with the vegetation which holds it.

The bush-clad dunes rise from these knolls and exceed them somewhat in height, the sea-ward vegetation being almost entirely Brachylæna, while behind the crest Amatungula (Carissa), Red Milkwood (Mimusops caffra), Scutia Commersoonii, Eugenia capensis, and other shrubs intermingle, forming a dense jungle where undisturbed.

The present trouble has arisen rather through the removal of the outer knolls than through the removal of the bush-clad dune, unless indeed the removal of the latter allowed the wind to gradually remove the former; this gave the wind an additional fifty yards in which to dry and gain hold upon the sand, and it is mainly to the restoration and fixture of these outer dunes that work is now being directed. The work

consists of a series of plaited wattle screens, four lines of these running parallel to the sea fifty feet apart, and the first fifty yards above high-water mark, while similar cross-fences of the same nature connect these at fifty feet distances, the most exposed portion being thereby divided into twenty-six fenced kraals each fifty feet square. The wattled fences stand four-and-a-half feet high; they are made almost entirely of Brachylæna from behind the dunes, with uprights eighteen inches apart, and are plaited open enough to allow sand to pass through, but still close enough to stop its speed if drifting. The four screens, one behind the other, form consequently for the present an effective stop to all drift, and all the sand drifting meantime behind the upper screen is simply the loose sand already there, which occasionally moves further back. The erection of these screens began in June, 1903, when six coolies were employed; subsequently the number was increased to about ten, who have been mostly engaged on this work ever since. The front screen runs continuous with the front of the lower dunes, and consequently carries beyond the break any wind and sand which may occasionally blow along the beach from the north. That from the sea has gradually accumulated behind this first screen until during nine months a littoral dune has formed along the whole length (600 feet) which extends about 25 feet back from the screen, and has a flat even surface level with the top of the screen except at the front, where an easy incline down to the old beach leaves about eighteen inches only of the first screen exposed.

The back face of this new dune is nearly perpendicular, the sand falling over the top as it is blown backward. All the front squares are consequently half-filled with sand, while the other halves of these and the whole of all the squares behind are entirely free of drifting sand, and apparently more clear of loose sand than they were when operations began. When the screens were erected the first line of squares were planted with vegetation suited to the locality, the plants used being Mesembryanthemum edule, Gazania, Ipomæa, Cyperus, and Scavæola. The first four of these held well from small plantlets, the fifth evidently does not transplant so easily, though some succeed. They were planted in lines, and formed a fine healthy carpet of vegetation until the sand forming the new dune poured in and submerged them. A square further back was sown with Maram grass, which failed to germinate, while another was planted with Maram grass plantlets raised in a separate nursery, and planted here three feet apart each way.

As water was scarce, and the Maram grass is a distinctly sea-sand grass, and often under sea spray, sea water was used for watering every second line of plants, while the others got fresh water, but the sea water proved too much for the plants, and all so treated died, while the others are still alive, though not promising well. The formation of the new dune, and

the consequent submerging of the vegetation in the first line of squares, showed that though peace had been established within the squares, it was only temporary, and that sooner or later any vegetation established there was likely to be buried unless the fresh drift was stopped. Consequently, and without further protection, the level surface of the new dune, as well as its face, has been planted with the same plants as were formerly used in the first squares, and the surface somewhat fixed by a mulching with sifted stable manure. The plants have already taken hold, and promise to succeed, and as they include the kinds already binding the adjacent front dunes there is every prospect that they will hold and bind the dune, and grow through any sand that may blow on, raising the level of the dune in time to be equal with the others in the neighbourhood without extending it much further backward. Probably this would be assisted by erecting another screen some distance in front of the present one, so as to give the wind no hold upon the sand, and should that also form a dune have it planted with Cyperus as it forms. But, meantime, the squares behind the new dune should be dealt with while quietness prevails, lest any disturbing element again break the front dune loose. Meantime there is no difficulty in raising bush vegetation so as to restore the bush barrier which originally existed. The indigenous kinds suggest themselves, but none of them are so easily or so rapidly raised as exotics, of which Acacia cyclopis and Acacia saligna are the best for such a position. These can be sown broadcast (after the seed has been scalded in boiling water), and covered with an inch of stable manure, which is obtainable at hand in this case. Among these should be introduced roots of the Wild Banana (Strelitzia angusta), as well as seedlings of Amatungula (Carissa grandiflora), as both these find their way through if by chance the sand ever comes in on them again. Eucalyptus gomphocephala is also adapted to this kind of site.

The present interesting reclamation works, which have cost so far about £120, reflect great credit on those who have taken them in hand, and the need for them should cause the Durban Corporation to be careful in regard to the issue of firewood licenses which can be used on the dunes, a practice recently if not still in force, and which will lead to further trouble if allowed to continue. This drift, comparatively small though it is, should also prove a warning in dealing with the Zululand coast, where a much larger and more difficult drift could easily be started.

The above was written in March, 1904. The Back Beach work was again visited in February, 1905, when it was very satisfactory to find that the littoral dune still remained intact, at the same height as formerly, and fairly well fixed by the vegetation which had been planted. The width of the dune had increased somewhat through sand drifting

landward, but the level surface was being planted as it formed. Acacia cyclopis and A. saligna had been sown in the inner squares, but without success, and plants were now being planted of these kinds. On the whole, the work remains very satisfactory, and promises every success.

Another small drift has been taken in hand by the Public Works Department, close to Addington Hospital, but the work is not yet far enough on to show what the result will be.

The cutting and removal of bush on various parts of the dunes continue, or at least are not strictly prohibited, and the Corporation is thereby allowing trouble and expense for future years to be forced upon them.

CHAPTER XXVI.

GOVERNMENT ACTION IN TREEPLANTING.

To make it clear what action Government has taken with regard to treeplanting, it is necessary to review its action in connection with forestry in general, in which Conservation and Afforestation both play important parts. For this purpose the following historical sketch from my Annual Report 1902, is introduced, together with the portion of the same report dealing with afforestation, in which the principle of the Government policy in its own afforestation is sketched out:—

"HISTORICAL.

"As early as 1853 (under Ordinance No. 4, 1853), it was made lawful 'for the Lieutenant-Governor, with the advice of the Executive Council, from time to time, by proclamation, to make provision for the preservation of the timber and bush growing on the lands belonging to the Crown, and for regulating the granting of licences for cutting or using the same, or leasing the timber and bush growing on such lands.' To give effect to such regulations, a penalty not exceeding twenty pounds was allowed for every offence, or, as an alternative, imprisonment with or without hard labour for any period not exceeding three months. Under this Ordinance regulations have from time to time been framed, its action having also been extended over Zululand (by Zululand Proclamation II., 1887), and even now the forests are administered under the same Ordinance, its only competitor, a drastic Bill brought into Parliament in 1891, having found no favour.

In 1880 a Government Commission reported on the forests of Natal, and, after hearing much evidence of constantly increasing destruction of forests, recommended the appointment of a Forest Officer, which recommendation, however, the Government did not act upon at the time.

In 1889 Mr. H. G. Fourcade, of the Cape Forest Service, spent nine months on special duty in Natal on purpose, as he summarises his instructions:

(1) To report on the condition of forests on Crown and Trust lands, making suggestions for their conservation, improvement, and extension;

(2) To report on the feasibility of creating artificial forests of indigenous and exotic trees, and of meeting from these the demand for timber for railway purposes;

(3) To report on the suitability of indigenous timber for railway purposes; and
(4) To consider the question of the establishment of a Forest Department in the Colony, and to furnish a scheme for its organisation.

Mr. Fourcade submitted a most exhaustive and lucid report, in which again systematic organisation was urged, and a general plan of the necessary action sketched. Mr. Fourcade was, however, allowed to return to Cape Colony, and in 1891 Mr. Schopflin, a Baden forest officer, was appointed Conservator, on three years' engagement. I have failed to obtain a single paper having reference to Mr. Schopflin's period of service, but the demarcation work done by him still exists, while the Bill presented to and rejected by Parliament in 1891, and the Rules and Regulations published under Proclamation No. 5, 1892, show that he made an honest endeavour to rectify matters. However, the Colony was at the time short of funds, and, as during the year 1891-1892 the sale of wood realised £725, while the expenditure of the Department was £1,942, difficulty was experienced in having sufficient money voted for demarcation and plantation work, and Mr. Schopflin resigned his post and returned to Europe.

The collection of forest revenue and the payment of forest officers were thereupon handed over to the Surveyor-General's Department, and the cost of supervision brought on a par with the revenue by placing the duties, formerly performed by a staff of Forest Supervisors, in the hands of the Natal Police, with only an allowance of 10s. to 25s. per month for each supervisor, and in some cases the assistance of one or more Native forest guards. In the absence of trained forestal control, the regulations in force were considered irksome, and the tariffs high, so easier fresh ones were promulgated under Proclamation 9, 1896, which, inherently weak, gained nothing in the method of carrying out, and were open to considerable abuse. In a report in papers A. and M. 2,356, 1902, I have at some length described various abuses found by me to be in use in the forests, under which abuses the leakage in revenue and material might be considerable, and in practice I find has been considerable, but in connection with these I distinctly exonerate the forest officers, who, so far as my evidence goes, acted up to their powers and instructions, and received few queries.

The Regulations as carried out were insufficient to protect the forests, and, covertly, rather legalised their destruction; but the cost of administration was exceedingly low, and the revenue sufficient to meet it; consequently, an apparently satisfactory position was produced, which probably justified Government taking no further action, though on closer professional examination the losses through waste, unprovident forestry, and the opportunity for illicit removal of forest produce were found to change the position altogether, and to

prove the apparent advantage to be a serious loss, which, if continued, would ultimately clear the Colony of timber without giving any return beyond the current cost of supervision.

Zululand fared better than Natal, as the Governor's powers there allowed him to regulate by Proclamation what would have required a Forest Law in Natal. Proclamation Zululand XI., 1894 (amended as to tariff by Proclamation Zululand No. XV., 1895), is still in force, and of much more inherent value than the Natal Regulations, while one Forest Officer, who had served under Mr. Schopflin, and afterwards migrated thither, maintained throughout, so far as his district was concerned, some measure of systematic Forestry.

The Zululand forests were also, fortunately, under Proclamation, in the care of the Magistrates, while in Natal, even the ordinary responsibility of the Magistrates was to some extent nullified by the existence of the Forest Officers.

The abuses mentioned above were almost all of a technical forestal nature, which could readily enough be overlooked, or considered too difficult to grapple with, except under expert advice, which was not at hand, and they did not press heavily on any individual or class of individuals, consequently what were considered more urgent matters occupied the attention of legislators during the first few years of Responsible Government.

Several legislators appear, however, to have been persistent in their endeavours to have matters rectified, and in 1900 the subject of Forestry was again brought before Parliament; this time by the question, put by Mr. Maurice Evans:—"Will the Government take into early favourable consideration the formation of a Forestry Department in the Colony, having for its objects:—

(1) The conservation and judicious extensions of the natural bush forests of the Colony, so as to endeavour to effect:—
  (a) Prevention of destruction at present going on;
  (b) Scientific cutting so as to prevent waste, and yet encourage young growth;
  (c) Planting and extension as a fund for future years;
  (d) Do what is possible in this connection to preserve the natural water supply and prevent deterioration of climate;
  (e) Endeavour to preserve the natural beauty of the Colony in so far as it is due to the presence of forests.

(2) The introduction and planting of exotic trees of economic value, with a view to:—
  (a) Grow in the Colony some portion of the timber now imported;
  (b) Experiment with trees new to the Colony, which yield economic products;
  (c) Assist farmers and others in the formation of plantations;

(d) Do what is possible in this connection to conserve water supply, increase the natural beauty of the Colony, and prevent deterioration of climate."

The reply was that Government would take the matter into consideration, and communicate with the Cape Government with a view to ascertaining what would be the probable cost of such a department. Some correspondence passed, and during 1901-1902, slight provision was made for the establishment of a Forestry Department, and the Central Experiment Farm, Hilton Road, was purchased, with the intention, inter alia, of making a start there with afforesting operations.

Early in 1902, Mr. Claude Fuller, Government Entomologist, visited the Cape, and inspected part of the Forestry work, and on his return advised that Mr.J. Storr Lister, Conservator of the Eastern Conservancy there, should be consulted, and if possible that he should visit Natal, study the conditions, and place before Government a scheme for the formation of a Forestry Department on lines similar to those of the Cape service. Mr. Lister did so during May, June, and July, and after visiting all the better forests of Natal, Zululand, and Vryheid, submitted a report (Agricultural Journal, Vol. V., No. 19, November 21st, 1902), which may be regarded as the foundation on which the present development of Natal Forestry is based, and in which all the points raised in Mr. Evans' question receive attention. He is careful to point out the value of the indigenous forests, and states: "The policy of the Government would appear to lie more in the direction of afforestation than in the proper conservation of existing forests. I submit that the one is bound up in the other, and they should be dealt with together, as has been done in the Cape Colony."

On Mr. Lister's recommendation I was offered the appointment of Conservator of Forests, which I accepted, in June, 1902, and my service dates from September 21st, 1902, while as I was transferred from the Cape service under Section 13 of the Civil Service Act, 1894, with previous service in Cape Colony, the appointment in some measure insures the foundation of a continuous, progressive, and permanent forest policy. Such was a most urgent need, previous action having been make-shift, or of the nature of advice only, except Mr. Schopflins, in which the element of permanency was absent.

The Forest service now becomes a division of the Department of Agriculture, under the ministerial control of the Minister of Agriculture.

AFFORESTATION.

Afforestation is one of the primary objects of the Government's present forest policy, and has also been urged in all previous reports. The expenditure recommended by the various authorities varies considerably, and it has been implied by some that in any scheme adopted the Colony must

commit itself to a perpetual heavy annual expenditure, equivalent to one or other of these recommendations. I have not, however, seen any estimate which purports to meet Natal's requirements; those seen being only what were suggested as workable schemes which would yield returns proportionate to the expenditure. A workable scheme may be as large or as small as the Government may wish, from £100 up to £100,000 per annum, the necessary conditions in either case being:—

(1) That Government is satisfied that it will be a profitable investment; and

(2) That the Colony can afford to invest the amount.

On the former point I cannot do better than quote advice given to the Cape Government by its Consulting Forest Officer, Mr. D. E. Hutchins, Conservator of the Western Conservancy, viz.:—

> "During 1896 the quantity of pine wood imported into Cape Colony amounted to 4,967,945 cubic feet, valued at £215,693. The greater portion of this importation could be supplied from *properly grown* Cluster pine plantations. It might be found necessary to zinc the Cluster pine timber. This would render it more durable and less inflammable than the present imported wood. As was shown in my annual report for last year, five farms of 6,000 acres (the Malmesbury farms average about 6,000 acres each- planted with Cluster pine, at £2 per acre, would supply the present demand for imported pine and deal wood; 30,000 acres planted at £2 per acre would cost £60,000. Quadrupling this expenditure for interest and upkeep for 35 years (*vide* the calculation given at page 26 of my Annual Report for last year) we arrive at an expenditure of £214,000. For this expenditure the country would obtain timber which costs us now £216,000 yearly, or considerably more if importations *via* Natal and Delagoa Bay be added; and which, in 35 years (allowing for the rise in the value of wood, we shall hardly obtain for £250,000. In other words, for every £1 spent now, the country would reap an annual revenue of about £1 in 35 years, and a quarter of a million pounds sterling would yearly be kept in the country instead of being paid to the foreigner. This calculation supposes that the plantations are on a line of railway, and sufficiently large to keep sawmills running and zincing machinery occupied."

Natal is in much the same position as Cape Colony with respect to its timber supply. Taking the three years before

the war, returns show the imports to have been of the following declared values, viz.:—

	Unmanufactured.	Manufactured.	Total.
	£	£	£
1896	312,241	65,140	377,381
1897	249,356	58,949	308,305
1898	159,975	40,598	200,573
Total...	£721,572	£164,687	£886,259
Annual Average	£240,524	£54,896	£295,420

These values are almost entirely for material which could be grown in Natal, and though part of it may have been passed through to the Transvaal, the fact still remains that if an equal amount of marketable material of the same or a similar kind had been grown in Natal, and standing ready to cut, the price paid for imported pine or gum timber could have been retained in Natal, whether the material was used in or beyond Natal, and a large population could have been engaged growing, felling, and dressing that material. The demand in and beyond the Colony is sure to be maintained and increased; the supply in timber-exporting countries is rapidly decreasing, and unless preparation is made here meantime for the future supply of housebuilding and sleeper timber, a permanent timber famine is certain to arrive sooner or later. The import for the years 1896 to 1898 averages 5¼ millions cubic feet per annum; allowing that plantations here average an increment of marketable timber of 150 cubic feet per acre per annum for all valuable kinds, then to meet the total import a fully stocked standing area of 35,000 acres would be required, or on a 35 years rotation the afforestation of 1,000 acres per annum for the first 35 years, and the felling and reproduction either naturally or artificially of an equal area per annum afterwards. More rapid planting would, however, be a decided advantage at first, to allow an accumulation for emergencies or increased demand, especially as the stock continues to increase in value with age for many years, and the European population is expected to increase rapidly.

Now, although I roughly estimate the above as the present requirement of the Colony for sawn timber, I put forward no inflexible scheme which would involve the planting of that area per annum, without fail, because the second consideration comes into force, viz.:—Whether the Colony can afford to invest money for such a period. Afforesting in Cape Colony varies in cost from £2 to £10 per acre; here labour is more difficult to obtain, and the price may rule higher, but allowing an average of £7 per acre, and the land value of, say, £3 per acre, or, say, £10,000 per annum, the result after 35 years will be sufficient material to meet the

present annual demand, and keep in the Colony £250,000 per annum. This allows a very large margin for harvesting and marketing, as well as for any partial failures, damage by hail, fire, or any other cause, or, which is better, it allows for expenditure in protection against fire. But if the Colony is not prepared to spend £10,000 per annum at present on treeplanting, it can spend whatever it can conveniently afford; the result is proportionately almost the same, and the import will in that case be reduced only in proportion to the planting effected. So also, if found necessary in future, extension can be temporarily suspended, and only the cost of maintenance would then be incurred.

My proposal is to proceed at present with afforestation at whatever pace the Government is prepared to find the funds, but keeping in mind that the actual requirement of the Colony is not less than has been stated. I recommend the Government, however, to adopt a settled and continuous policy, so as to allow its officials to arrange for work years ahead.

I also urge that whether much or little be immediately expended on plantation work, an area of not less than 50,000 acres of suitable Crown Land (making allowance for included unsuitable ground- situated in forest country either in Natal or Zululand, or both, and not distant from existing or projected railways, be selected and reserved for future afforesting, and permanently saved from alienation, though much of it might be leased until required. Such leases should not exceed 5 years, as the 33 years proposed in the Agricultural Settlement Scheme (Government Notice 480, 1902) would only allow land to be resumed at the time when, if the Colony rises to the occasion, the planting should be practically finished.

And, with reference to the selection of land for afforestation, equal care is required in the selection of this as of agricultural land, the theory that any land unsuitable for agriculture can be thus utilised being a delusion.

Work is being concentrated meantime on to the planting of the upper portion of the Central Experiment Farm, Hilton Road, but it is highly desirable that an experimental coast plantation be also taken in hand at an early date, the kinds of trees and conditions of culture being exceedingly different there from those at Hilton Road; Karri, Kauri, Araucaria, and other trees suitable for the Central Experiment Farm, being well worth culture, at least experimentally. Proposals with regard to such a plantation, including a coast nursery, have been submitted, and may come up next year.

In the Upper Districts also, where no timber is meantime sawn from the indigenous forests, a large local timber supply would reduce the price of timber, and relieve the railway of that much haulage which meantime Natalians have to pay for.

The intention in the Government afforestation is to produce sleepers and house timber which meantime have to be

imported, but not to come in conflict with local and already established timber industries, such as the cultivation of Wattle Bark and the supply of firewood, in which industries there are already about 25,000 acres under Black Wattle (Acacia mollissima) in the Midland Districts. All such industries will, however, be watched and fostered."

Following up the lines sketched in the above report, work has been actively carried on at Cedara in the afforestation of the upper parts of the Zwartkop, with occasional tongues of plantations extending down through the Central Experimental Farm. At present (January, 1905) about 400 acres are under trees, and other 400 acres are broken up and under preparation for sowing or planting this season, which work is now in progress. Most of the ground presently covered is in pines, intended for deals, and similar uses; part is, however, in gums intended for sleepers; and part in Black Wattles, intended for fuel and poles for the farm establishment, and for shelter for the orchards, etc. An arboretum where all available kinds are planted widely to become specimen trees, and a forestal arboretum, where two acres each of many kinds are planted, forest fashion, are among the features of the work. Experiments in the sowing and planting of Black Wattles at many different distances, and by different methods, as well as experiments with various manures upon Black Wattle, claim attention. But perhaps the most important item from the visiting tree-planters point of view is the nursery, in which a large and varied stock of young forest trees is always on hand, intended for supplying to the public at a small charge; all surplus being used in the forest work on the farm, for which special batches of the most approved kinds are also raised in the nursery. Fresh and reliable seeds of the best kinds of forest trees are also kept in stock, and supplied to the public, the stock in hand on June 30th, 1904, being 4,372 lbs. of seed, representing 97 kinds. Perishable seeds are not stocked, but are sown when obtained, and plants offered for sale. The sale of trees and seeds is under the conditions of the following circular, and it may be well to call attention to the rule that prepayment is required in order to avoid delay when the trees are wanted at once:—

DEPARTMENT OF AGRICULTURE.

NOTICE.

CONSERVATOR OF FORESTS, No. 1, 1905.

To encourage tree-planting, Transplants and Seeds of Forest Trees are supplied by Government, so far as in stock, at the undermentioned rates, exclusive of carriage, from the Government Nursery, Cedara.

Transplants of Eucalypts, Pines, Acacias, Casuarinas, Cupressus, etc., about 25 trees in each tin, at 8s. 4d. per 100 trees.

Trees in separate tins at 1s. each.

Transplants of scarce kinds, larger trees, or surplus stock, when available, will be charged at special rates, which will be furnished on application.

Tree seeds, in variety, at 1s. per packet. Price per pound, which fluctuates, will be furnished on application.

Packing and postage of seed, where required, charged 1s. per lb. extra.

Orders for present or spring delivery should be addressed to the Forester, Cedara, and must be accompanied by a remittance in cash or postal order.

T. R. SIM,
Conservator of Forests.

Office of Conservator of Forests,
17th February, 1905.

The sale of trees to the public was rendered necessary through the difficulty experienced by the public in obtaining forest-tree transplants from the local nurserymen, such trees going so rapidly past the selling stage that the nurserymen find them unprofitable, except at a high price, whereas in this case the trees can be used up in planting on the Government plantation before they get too large, and the loss thereby avoided allows the trees to be sold at the tariff mentioned, as cost price. Larger trees, in separate tins, are sold at higher prices, up to 1s. each. Care is taken, however, not to interfere with the lines in which local nurserymen meet the public demand satisfactorily, such as most kinds of fruit trees and ornamental shrubs, and future action will be guided by the supplies provided and prices charged to the public by local nurserymen.

Sales to the public began in August, 1903, and from that date to June 30th, 1904, 100,643 transplants, 1,246½lbs. of seed, and 141 packets of seed were sent away, bringing a revenue of £505 9s. 1d.

The Nursery Statement for the year 1903-1904 is as follows:—

	Trees.
Trees used for planting on Central Experimental Farm	191,786
Trees used for filling blanks in above	5,800
Trees supplied to the public and to other Stations... ...	100,643
Transplants in stock, 30-6-1904	170,393
Trees in stock in separate tins, 30-6-1904	1,372
	469,994
Less stock in hand, 31-12-02 (as per previous report) ...	91,447
Trees raised, 31-12-02 till 30-6-04, but not including untransplanted seedlings	378,547

The public demand is increasing, and nearly another hundred thousand trees have been sent out to the public during the first eight months of year 1904-1905.

The trees sent out from the nursery to the public have given satisfaction and done well; they have been scattered all over the Colony, including such outlying localities as Paulpietersburg, Vryheid, Hlabisa, Polela, and Harding.

Subtropical kinds are not grown in the Cedara Nursery, but are now being raised for supply to the public in the coast nurseries.

One of these is at Empangeni, Zululand, where a plantation of 640 acres is in hand, about 200 acres having been planted this season mostly with subtropical kinds, rubber plants, or plants on trial.

A nursery is also being formed on the South Coast at Winkle Spruit.

Government is also sowing plantations of Wattles in connection with several indigenous forests, with a view to supply hut-wattles therefrom, and so prevent the enormous destruction which goes on annually by removal of hut-wattles from the natural forests. Six of these plantations are now in action, viz.: Bulwer, Inkazene, Ingeli, Impetyne, Winkle Spruit, and Pongola Bush.

The protection of all the natural Crown Forests by conservation measures is also reducing the destruction of young trees for hut-wattles, and tends eventually to the great improvement of these forests.

The reservation of 50,000 acres for Government plantation purposes, as urged in my report, has not yet been fully effected, although various areas connected with indigenous forests have been proclaimed Demarcated Forest, with a view to forming part of the scheme, and further areas are under consideration in connection with the allocation of Zululand. The more forest plantations there are, each with a nursery connected with it, so much the more convenient to the public will the supply of nursery transplants become.

Among other measures taken by Government to induce the public to develop industries in the Colony are those under Government Notice No. 644, 1890, wherein certain rewards are offered, under published conditions, including the following for timber industries:—

No. 11. Railway Sleepers, creosoted, or treated by other approved process, a minimum £5,000 value having to be made during one year, the first reward being £1,000, and the second £500.

No. 17. Eucalyptus Oil, a minimum of £1,000 value, having to be made during one year for a first reward of £350, or second of £150. A series of prizes for plantations of timber-trees have also been offered, through the Natal Farmers' Union, by Maurice Evans, Esq., a prize of £25 being offered in each Division of the Colony under specified conditions. Taken

as a whole, the facilities meantime offered to the public to obtain and plant trees, either on a large or small scale, are such as should and will have an enormous effect in advancing the home comfort and beauty of Natal, and also in supplying a timber-growing industry to the Colony, promoting closer and more permanent settlement for that end, and eventually reducing the cost of timber material locally and retaining in the Colony an enormous sum, which meantime goes abroad annually for timber.

These facilities are self-developing and self-sustaining, the nursery tariff being so arranged as to meet the cost of maintenance and management of the nurseries, taken apart from other plantation work, though the latter makes a clear way for all surplus stock. Districts which show a large and increasing demand are receiving consideration with a view to the establishment of branch nurseries when these appear to be required, so each district decides by its present demand what further facilities will be extended to it in the future.

CHAPTER XXVII.

MALLET-BARK.

During November, 1904, attention was drawn by various correspondents to a tanning material which had lately been arriving in Europe in considerable quantity from Western Australia, and which threatened to have a prejudicial effect on the sale of Natal Black Wattle Bark. The source of this supply was not definitely known, consequently the available supply, and the possibility of culture also, remained doubtful, pending further investigations. These were at once instituted. Meantime Mr. H. von Bulow, Dalton, informed me that he had ascertained that it was the bark of Eucalyptus occidentalis, and that it had yielded the following analysis:—

Tanning matter, 49.5 per cent.
Non-tanning matter, 6.6 per cent.
Water, 18.8 per cent.
Non-soluble substance, 25.1 per cent.

And he adds that it is being supplied at the same price as Black Wattle Bark. Enquiries at Kew were referred to the Director of the Imperial Institute, who replied as follows, under date January 28th, 1905:—

"Your enquiry relative to the use of Mallet Bark as a tanning material, addressed to the Director of the Royal Gardens, Kew, has been referred by that Department to the Imperial Institute.

"In reply I have to say that since 1903 considerable quantities of a bark, which is probably identical with that to which your enquiry refers, have been on the market in Germany, principally through Hamburg, under the name of 'Maletrinde,' and in France, *via* Marseilles, as 'Malletto.' In both these countries considerable interest has been taken in the product, and attempts have been made to ascertain its botanical origin, but without success. It has, however, been suggested that it is the bark of either *Jasminum sambac*, or *Olea europea*. The principal evidence for the first of these identifications is that the bark of *Jasminum sambac* has the Malay name of 'Malati,' from which it is supposed the name 'Malet' or 'Mallet,' by which the new bark is known commercially may be derived.

"In this connection your suggestion that the bark is derived from *Eucalyptus occidentalis* is of particular interest, but it is curious that, so far as I am aware, no mention is

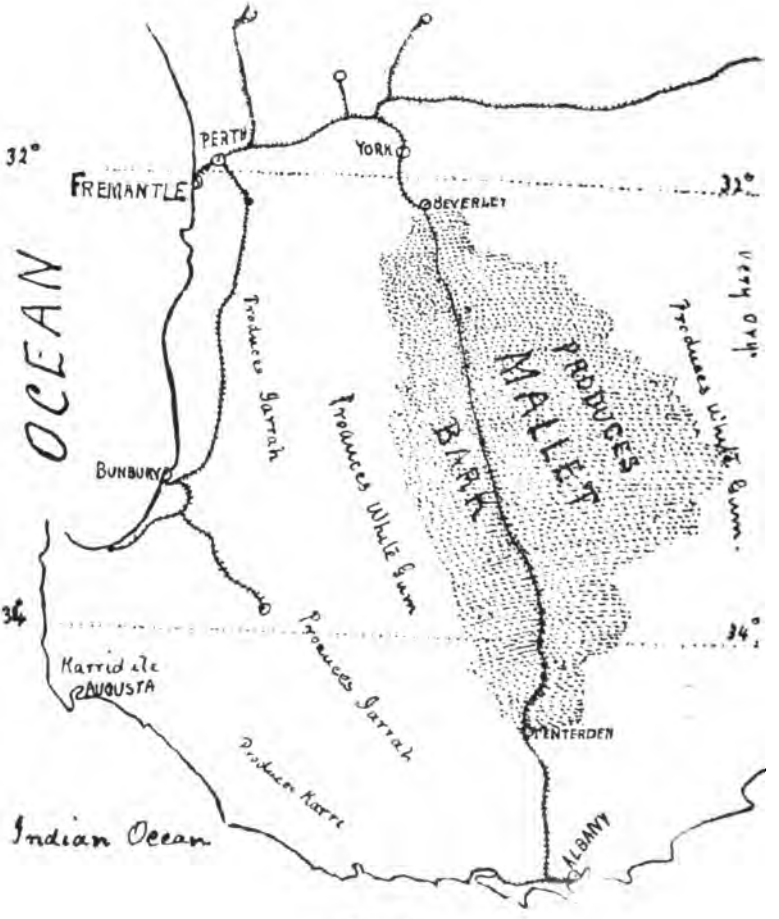

32°
PERTH
FREMANTLE
YORK
BEVERLEY
32°
OCEAN
Produces Jarrah
Produces Jarrah
Produces Whole Gum
PRODUCES MALLET BARK
Produces Whole Gum
BUNBURY
34
34°
Produces Jarrah
Produces Karri
Karridale
AUGUSTA
KENTERDEN
Indian Ocean
ALBANY

Fig. 101.

made in Eucalyptus literature of the tanning properties of Eucalyptus occidentalis.

"Further, such of the Eucalyptus barks as have been used for tanning contain, as a rule, red colouring matters which depreciate their value, but 'Mallet' bark appears to be free from this defect. It seems to me, therefore, that the botanical origin of the bark requires investigation, and I am taking steps to obtain information on this point.

"The bark is obtained from South Australia, and is exported from Freemantle and Albany, and the following figures have been given as the quantities exported from these ports since the trade in this product began:—

"1903, 500-600 tons; 1904, 4,000-5,000 tons; and in 1905 it is estimated that about 50,000 tons will be exported.

"The bark is said to contain from 35 to 40 per cent. of tannin, and to yield a firm, tough, yellowish leather, quite free from the reddish tint given by Wattle barks. Mallet bark sells at the present time at from £12 10s. to £13 per ton, whereas Wattle bark brings from £10 to £13 per ton.

"So far Mallet bark has not appeared to any extent, if at all, on the English markets, but there can be little doubt that if it produces leather free from the pink tint characteristic of Wattle, and is as rich in tannin as is stated by the German importers, it will meet with a ready sale in this country when once it becomes known."

An enquiry sent to Mr. J. H. Maiden, F.L.S., Director, Botanic Gardens, Sydney, evoked the following reply, dated January 24th, 1905:—"In reply to your letter referring to Mallet bark, I beg to inform you that this name is applied to the Flat-topped Yate (Eucalyptus occidentalis) of Western Australia. The name Mallet has been invented by the persons who are interested in exporting the bark; no wonder you could not trace it."

In reply to an enquiry sent to the Secretary, Forest Department, West Australia, the following was received:—

"The bark referred to is obtained from the tree locally known as the Flat-topped Yate (Euc. occidentalis). Various analyses of the bark show that it contains from 28 to 45 per cent. of tanning matter.

"Many thousands of tons have been exported during the last two years.

"Eucalyptus occidentalis is distributed over a large area of country on either side of the Great Southern Railway line as shown on litho. herewith (Fig. 101), but I am unable to give any estimate of the quantity still available, as this tree is said to extend to a very considerable distance to the eastward of the line. The Mallet is only to be found in natural bush."

That the industry is an entirely new one is very evident, since Mr. J. Ednie Brown, in his exhaustive report on "The Forests of Western Australia and their Development" (1899)

makes no reference to E. occidentalis, nor does he mention any industry in Eucalypt bark. In the Western Australian Journal of Agriculture, May, 1904, Dr. Morrison, Government Botanist, in writing of the number of dead trees along the Great Southern Railway (mostly killed by fire), mentions "Mallet" as being exploited for tanning bark, and refers it doubtfully to E. salubris, though in the same Journal for September, 1904, he identifies it authoritatively as E. occidentalis.

The country shown in the litho. sent as being the district from which Mallet is obtained nearly corresponds with that shown by Mr. J. Ednie Brown as producing "York Gum" (*E. loxiphleba*), "Yate" (*E. cornuta*), "Sandalwood" (*Santalum cygnorum*), and Raspberry Jam (*Acacia acuminata*), which he estimates to cover 4,000,000 acres, though the product from this, and including also the country occupied by Wandoo (E. redunca), which he estimates at 7,000,000 acres, is set down in his estimate of matured standing timber as only 7,000,000 loads.

This shows, then, a very sparse stocking, *i.e.*, about three-quarters of a load per acre, and I am informed by Mr. Kelly, District Forest Officer, Pietermaritzburg, who has been through the district, that it is a wilderness of scrub, mostly uninhabited, excessively dry, and containing trees of timber size only along the river beds.

The figures given by Brown can only be accepted as wide guesses, but assuming from them four million loads as the standing crop of the timber on the "Mallet" District, and that this is produced mostly by four species, then one million loads may be roughly estimated as the Mallet timber available, and fifty thousand loads of bark as the possible Mallet bark available for shipment, except material is also obtainable from small trees.

That is to say, if fifty thousand tons be exported during 1905, as is predicted in the estimate given by the Director of the Imperial Institute, and an equal export be maintained in subsequent years, then the whole crop of Western Australia would be exported within four or five years.

The question then arises, how soon will another crop come on? This can probably be best answered by stating the behaviour of E. occidentalis in cultivation in South Africa.

I have had trees of it in my care from 1888 to 1902, and know its peculiarities of culture, though I was not aware of its bark value. On deep, rich alluvial land it grows well, though not very rapidly; on shallow and poor soil it makes miserable growth, and would not produce a ton of bark per acre in half a century. It is, then, from the alluvial valleys only that a growth may be expected. That regrowth is not likely to yield a crop of bark equal to the first in less than thirty or forty years, though, of course, the amount of pro-

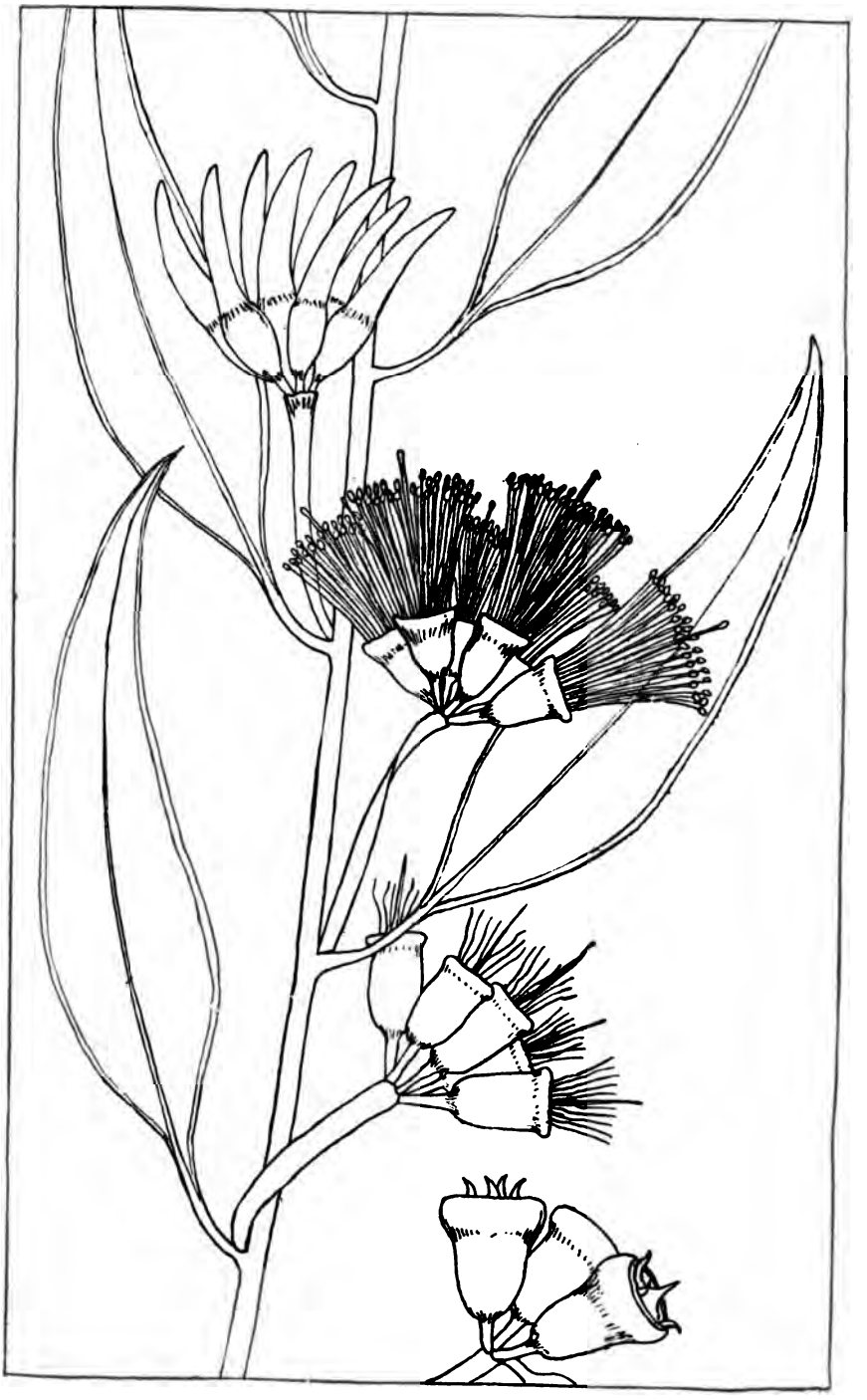


FIG. 102.

tection from fire it receives will materially affect both the quantity and the period. A few well situated trees may yield in about twelve years; others will take fifty years or more. From these details, and considering that it belongs to a comparatively uninhabited country, where grass fires sweep through large tracts of country, it seems probable that small areas carefully raised in artificial plantations will bring in a return more quickly than any extensive area of natural bush, and that even in these plantations careful selection of land is necessary. That a perpetual annual supply of fifty thousand tons can be marketed is highly improbable; that an almost total collapse of the supply will take place after the first few years is much more probable, and that no large second supply will come in except from artificial plantations is very likely. But it is also probable that distance from rail will make the first crop too expensive to handle long before the supply is exhausted, and that driblets will arrive from outside as occasion offers, and as new branch railways are formed, if such are ever formed in that district.

On the whole the effect of Mallet bark on the Natal Wattle industry seems likely to be temporary, and will probably be more of a scare than an actual realisation, though it is too early yet to say so definitely.

Now with reference to the culture of "Mallet bark" in Natal, I have no hesitation in saying that it will never oust or even affect the Black Wattle industry. Soils suitable for "Mallet" are scarce, and the area of such is limited; even on best soil the growth of bark is much less than that of Black Wattle, while there are many thousand acres under Black Wattle in Natal which would not carry "Mallet" at all. The timber is not large at the best, and its timber qualities are not well known, so I would advise planters to hesitate before planting extensive areas. It was ascertained that no seed is available meantime in South Africa, so a quantity has been ordered from Australia for Departmental use and public supply, and for the production of seed-bearers if the industry does happen to expand. That the cultural industry will be taken up in West Australia does not seem likely; if taken up anywhere it is most likely to be in South-West Cape Colony, where the winter rainfall and dry summer agree most closely with its natural climate.

The accompanying illustration of Eucalyptus occidentalis (Fig. 102) has been prepared from trees grown in Cape Colony, and show its characteristics. I have just obtained from Mr. J. M. Egner, Pietermaritzburg, a sampe of "Mallet-bark," obtained from Europe. It is a dense, close-fibred bark, about a quarter-inch diameter, almost resembling timber, and with streaks of resin through every piece. This has been submitted, together with a sample of Natal Black Wattle Bark, to Mr. A. Pardy, F.C.S., Analyst for the Agricultural

Department, who supplies from these the following analysis:—

	Black-wattle.	Mallet-bark.
Soluble matter	47.90	51.48
Non-tannin	11.94	12.23
Tanning matter	35.96	39.35

As an independent analysis this should form a reliable basis on which Natal growers can base their action in regard to Mallet-bark.

(Note.—Since the above was written advices from England show that Mallet-bark is now being quoted at £8 per ton in London, a price which must, for the present, materially affect the value of Natal Black Wattle bark.)

FIG. 30.—Juniperus virginiana, 8 years old.
In the Alexandra Park, Pietermaritzburg.

FIG. 29.

1. Acer negundo. *Box Elder.*
2. Cupressus horizontalis. *Spreading Cypress.*
3. Casuarina leptoclada. *Beefwood.*
4. Pinus pinaster. *Cluster Pine.*
5. Thuya Lobbii.
6. Cupressus lusitanica. *Cedar of Goa.*
7. Pinus sylvestris. *Scotch Pine.*

In the Botanic Garden, Pietermaritzburg.

FIG. 31.—1. Salix babylonica. *Weeping Willow.* 2. Quercus pedunculata. *Oak.* 3. Cupressus pyramidalis. *Upright Cypress.*
In the Alexandra Park, Pietermaritsburg.

FIG. 32.—1. Cinnamomum camphora. *Camphor-tree.* 2. Cupressus lusitanica. *Cedar of Goa.* 3. Populus tastigiata. *Lombardy Poplar.* 4 Cupressus pendula-glauca. 5. Casuarina leptoclada. *Beefwood* 6. Catalpa bignonioides. 7. Liriodendron tulipifera. *Tulip Tree.*
In the Alexandra Park, Pietermaritsburg.

FIG. 34.—Pinus halepensis. *Aleppo Pine.*
Maritzburg College Grounds.

FIG. 33.—1. Thuya compacta. 3. Ailanthus glandulosa.
2. Eucalyptus rostrata. 4. Grevillea robusta.
5. Bauhinia Galpini.
In the Alexandra Park, Pietermaritzburg.

FIG. 35.—1. Cedrus deodara. *The Deodar.* 2. Cedrus Atlantica.
At Morningside, Pietermaritzburg.

FIG. 36 —Photinia eriobotrya *The Loquat.*
In the Botanic Garden Pietermaritzburg.

FIG. 37 — Agathis australis. *Kauri Pine.*

In the Botanic Garden, Durban.

FIG. 39.

1. Araucaria Cookii.
2. Azalea indica.
3. Sterculia diversifolia. *Currajong.*
4. Iuglans nigra. *Black Walnut.*
5. Camellia thea. *Tea.*
6. Ficus elastica. *India-rubber Tree.*

In the Botanic Garden, Pietermaritzburg.

FIG. 38—1. Quercus suber. *Cork Oak.*
2. Cupressus lusitanica. *Cedar of Goa.*

In the Botanic Garden, Pietermaritzburg.

FIG. 41.

1 Juniperus bermudiana. 4. Pinus halepensis. *Aleppo Pine.*
2. Thuya orientalis *Arbor-vitæ.* 5. Araucaria Cookii.
3 Pinus canariensis. *Canary Pine.* 6. Yucca alœfolia.

In the Albert Park, Durban.

FIG. 40.

1. Taxodium distichum. *Swamp Cypress.* 3. Cupressus macrocarpa. *Scented Cypress.*
2. Eucalyptus calophylla. 4. Cedrus deodara. *The Deodar.*

In the Botanic Garden, Pietermaritzburg.

FIG. 42.—1. Widdringtonia Whytii. *Mlanji Cedar.*
2. Belis jaculifolia (= *Cunninghamia sinensis*).
3. Pinus australis. *Pitch Pine.*
4. Casuarina leptoclada. *Beefwood.*
5. Castanospermum australe.
6. Grevillea Caleyi.
7. Grevillea Hilleana.

In the Botanic Garden, Pietermaritsburg.

FIG. 43.—1. Camellia japonica.
2. Pinus australis. *Pitch Pine.*
3. Cereus, sp.
4. Cupressus lusitanica. *Cedar of Goa.*
5. Rhus vernicifera.
6. Cinnamomum camphora. *Camphor.*

In the Botanic Garden, Pietermaritsburg.

FIG. 45
1. Spathodea speciosa. 2. Terminalia catappa.
In the Botanic Garden, Durban.

FIG. 44 — Trichilia emetica. *Umkuhlu*
In the Albert Park, Durban.

FIG. 46.—1. Cecropia peltata. 2. Sterculia alata.
In the Botanic Garden, Durban.

FIG. 47.—1. Aleurites triloba. 2. Rhus longifolia.
3. Cæsalpinia coriaria. *Divi-Divi.*
In the Botanic Garden, Durban.

FIG. 49.
1. Cedrela odorata.
2. Araucaria Bidwillii.
3. Tectona grandis *Teak.*
4. Baphia racemosa.
In the Botanic Garden, Durban.

FIG. 48.—Casuarina torulosa.
Near Esplanade, Durban.

FIG. 50 —Zizyphus mucronata.
In the Botanic Garden, Darban.

FIG. 51.—1. Pruned trees of Cupressus macrocarpa.
2. Erythrinia caffra. *Kaffir-boom.* 3. Tarchonanthus camphoratus.
In Durban Gardens.

FIG. 52 — 1. Jacuranda mimosæfolia. 2. Poinciana regia.
3. Manihot Glaziovii. *Ceara Rubber.*
In the Botanic Garden, Durban.

FIG 53 1. Ficus indica. *Banyan.* 3. Garcinia cochin-chinensis. *Mangostein.*
2 Cocos nucifera. *Cocoa-nut.* 4. Cocos plumosa.
5. Hedge of Bambusa Fortunei
In the Botanic Garden, Durban.

FIG 55.
1. Ailanthus glandulosus.
2. Cedrela odorata.
3. Poinciana regia.
4. Mimosa rubicaulis.
5. Pandanus utilis. *Screw-pine.*
In the Botanic Garden, Durban.

FIG. 54.
1. Pandanus utilis. *Screw-pine.*
2. Araucaria Cunninghamii.
3. Agathis australis. *Kauri-pine.*
4. Cocos flexuosa.
5. Phœnix reclinata. *Wild Date.*
6. Terminalia bellerica. *Myrobolans.*
In the Botanic Garden Durban.

FIG 56.—Acacia mollissima. *Black Wattle* grown alone.

FIG. 57.—Wattle Plantation, six years old. Noodsberg.

FIG. 58.—Wattle Plantation, twelve years old. Ravensworth.

FIG. 59—Wattle Plantation. Felling and Stripping.

FIG. 60.—Wattle-bark Drying Sheds. Ravensworth.

FIG. 61.—Wattle-bark Drying Sheds. Noodsberg Road.

FIG. 62.—Wattle-bark Drying Sheds. Noodsberg Road.

FIG. 63—Bark Drying Sheds and Mill New Hanover.

FIG. 64.—Interior of Bark Chopping and Bagging Shed. New Hanover.

FIG. 65.—Bags of Bark waiting for railage. Ravensworth.

FIG. 66.—Homestead. Ravensworth.

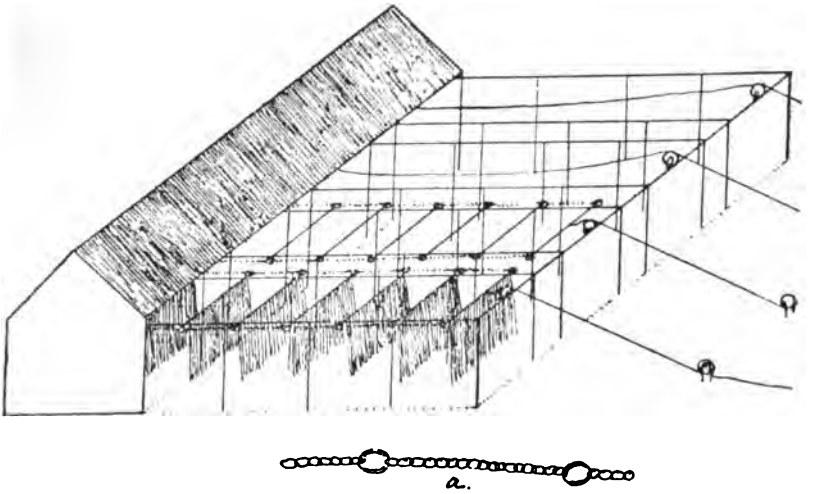


FIG. 67.—Sketch showing principle of the Town Hill Wattle Company's Drying Yar fitted for rapid indoor protection in case of rain.
a. Chain with rings at regular distances into which the drying-poles fit.

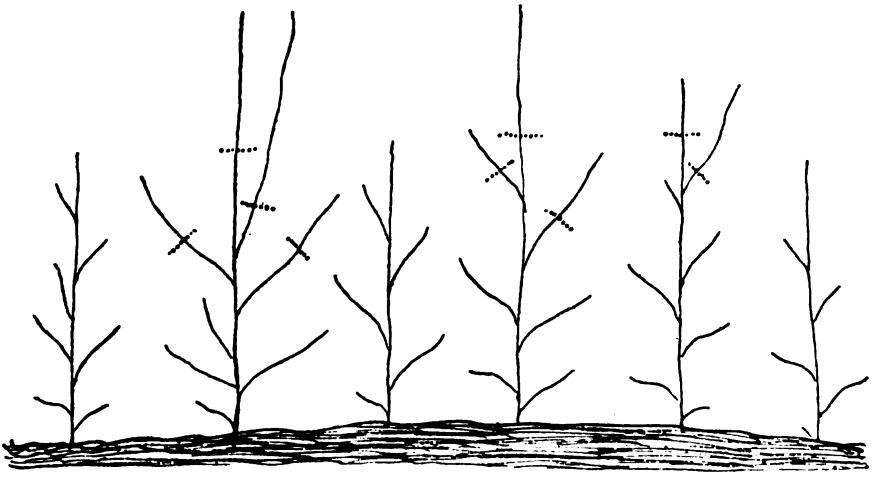


FIG. 68.—Sketch showing the method of pruning Wattle Trees practised by Messrs. Angus & Co., Ravensworth Branches are cut off at the dotted lines.

FIG. 70.
1. Hedge of Juniperus virginiana. 2. Pinus massoniana.
3. Acacia melanoxylon. *Blackwood.*
At the Native High Court, Pietermaritsburg.

FIG. 69.—1 Araucaria Cookii
2. Cupressus horizontalis.
3. Araucaria excelsa. *Norfolk Island Pine.*
4. Cinnamomum cassia.
5 Azaleas.
6. Aloe socatrina, with stapelias below.
In the Botanic Garden, Pietermaritsburg.

FIG. 71. Logs of Blue-gum being shipped.

FIG. 73.
1. Acacia melanoxylon. *Blackwood.* 3. Eucalyptus rostrata *Red-gum.*
2. Eucalyptus robusta. *Swamp Mahogany.* 4. Eucalyptus citriodora.
5. Eucalyptus globulus. *Blue-gum.*
In the Botanic Garden, Pietermaritzburg.

FIG. 72.
1. Eucalyptus globulus. *Blue-gum.* 2. Eucalyptus rostrata. *Red-gum.*
3. Eucalyptus diversicolor. *Karri*, about 30 years old.
In the Alexandra Park, Pietermaritzburg.

FIG. 74.—Araucaria Cunninghamii.
In the Botanic Garden, Durban.

FIG. 75.—1. Cryptomeria elegans. 3. Pinus pinea. *Stone Pine.* 2. Pinus pinaster. *Cluster Pine.* 4. Pinus insignis.
At Lynedoch Nottingham Road.

FIG. 76.—1. Border of Euphorbia. 3. Ananas.
2. Ravenalla madagascariensis. 4. Magnifera indica. *Mango.*
5. Acacia spectabilis.
In the Botanic Garden, Durban.

FIG. 77.—Pinus insignis, 14 years old, with Oaks below.
Alexandra Park, Pietermaritzburg.

FIG. 79.—Liriodendron tulipifera. *Tulip-tree*
In the Botanic Garden, Pietermaritzburg.

FIG. 78
1. Cupressus pyramidalis. *Upright Cypress.* 2. Pinus insignis. 3. Macluria aurantiaca. *Osage Orange.* 4. Cupressus horizontalis. 22 years old.
Alexandra Park, Pietermaritzburg.

FIG. 80.—Ceratonia siliqua. *Carob.*

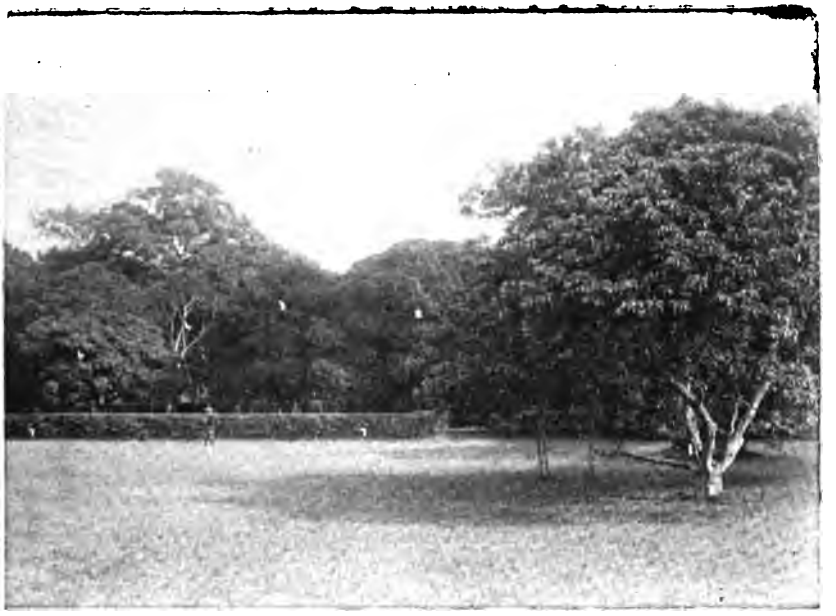


FIG. 81.—1. Nephelium Litchi. *The Litchi.* 4. Aloe dichotoma.
2. Mangifera indica. *The Mango.* 5. Aleurites triloba.
3. Psidium sp. *Mountain Guava.* 6. Mangifera indica. *The Mango.*
7. Hedge of Bambusa Fortunei.
In the Botanic Garden, Durban.

FIG. 82.—1 Lagunaria Patersonii. 4. Hedge of Frenella rhomboidea
2. Cupressus macrocarpa. *Oyster-bay Pine*
Scented Cypress. 5. Cycas revoluta.
3. Magnolia grandiflora. 6. Phœnix reclinata. *Wila Date*
7 Liriodendron tulifera. *Tulip-tree.*
In the Botanic Garden, Pietermaritzburg.

FIG. 84.

1. Cupressus macrocarpa. *Scented Cypress.*
2. Bambusa vulgaris. *Bamboo.*
3. Pinus pinaster. *Cluster Pine.*
4. Philadelphus grandiflora.
5. Camellia japonica.
6. Azalea indica.

In the Botanic Garden, Pietermaritzburg.

FIG. 83.—Cinnamomum camphora. *Camphor-tree.*
In the Botanic Garden, Durban.

FIG. 85.—Hibiscus tiliaceus. *Umlolwa.*
As a street tree in Durban.

FIG. 86.—1. Ficus elastica. *India-rubber Tree.*
2. Podocarpus Thunbergii. *Yellowwood.*
In the Albert Park, Durban.

FIG. 87.—Ricinus communis. *Castor-oil Plant.*
2. Ficus *species. Uluzi.* 3. Hedge of Cestrum.
In a Durban Street.

FIG. 88.—Acacia, *species Camel Thorn.*
Alexandra Park, Pietermaritzburg.

FIG. 89.—Ficus, *species*. *Mpai*
West Street, Durban.

FIG. 90.—1. Poinciana regia
2. Streletzia angusta
3. Grevillea robusta
4. Fan Palm.
In the Botanic Garden, Durban

FIG. 91.—1. Encephalartos. 2. Pandanus utilis *Screw pine.*
3. Hedge of Bambusa Fortunei.
In the Botanic Garden, Durban

FIG 92.– Phœnix dactylifera. *Date Palm*
In front of the Royal Hotel Durban.

FIG. 94.—Podocarpus falcata. *Yellowwood.*
In the Botanic Garden, Pietermaritzburg.

FIG. 93.—1. Spathodea speciosa. 2 Oreodoxia regia.
In the Botanic Garden, Durban.

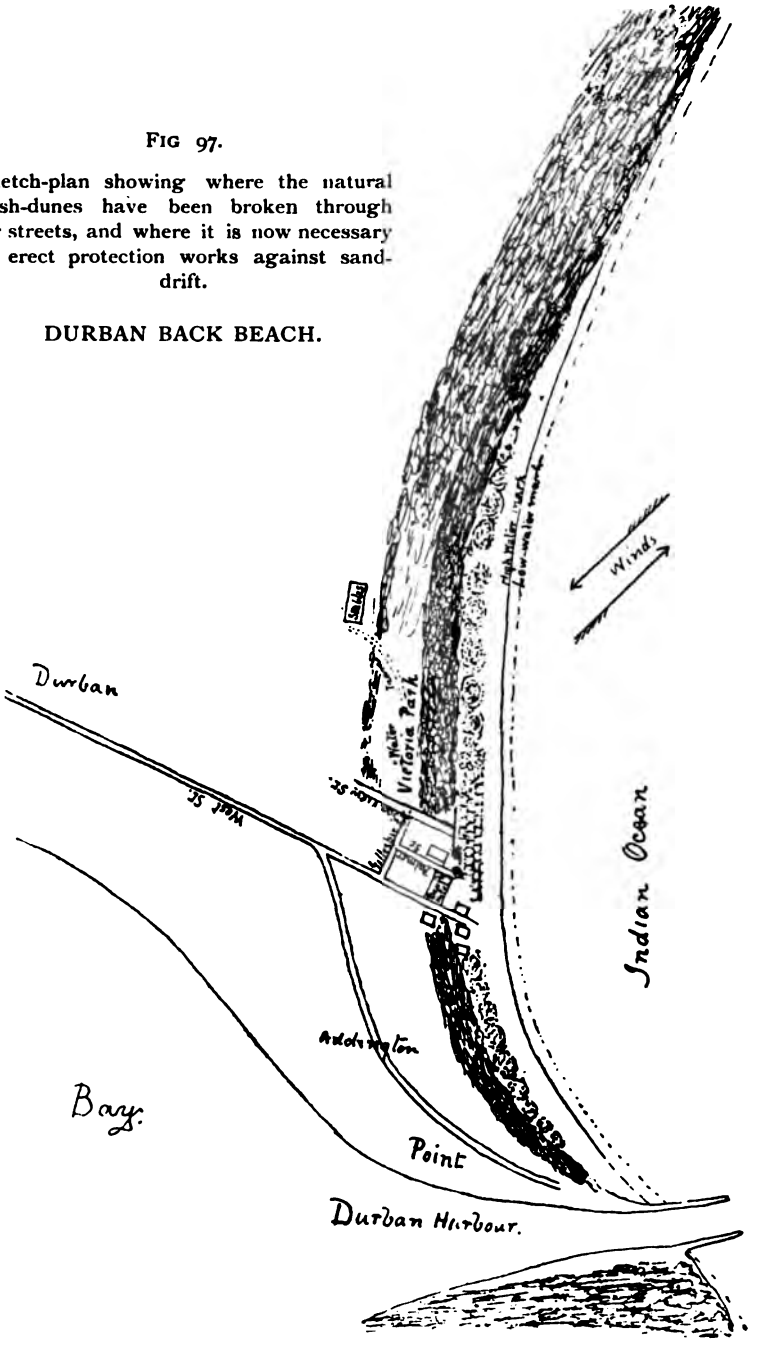
FIG 95. - Part of Government Nursery, Cedara.

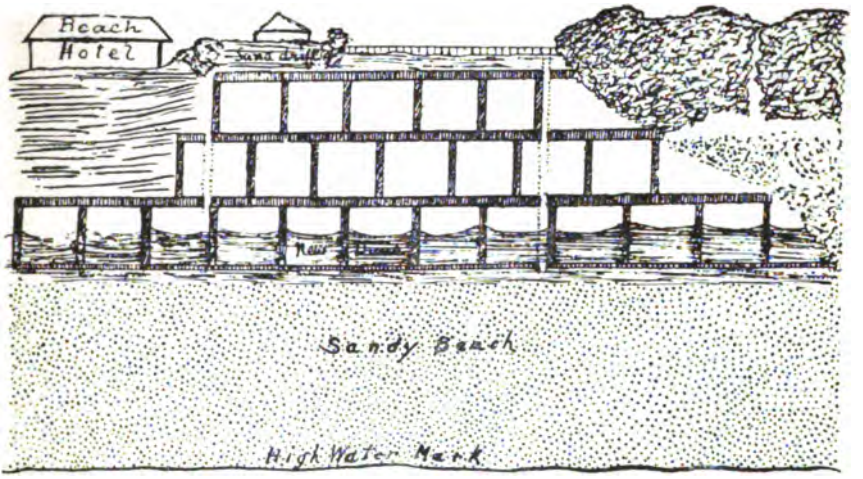
FIG. 96.—Part of Government Nursery, Cedara

FIG 97.

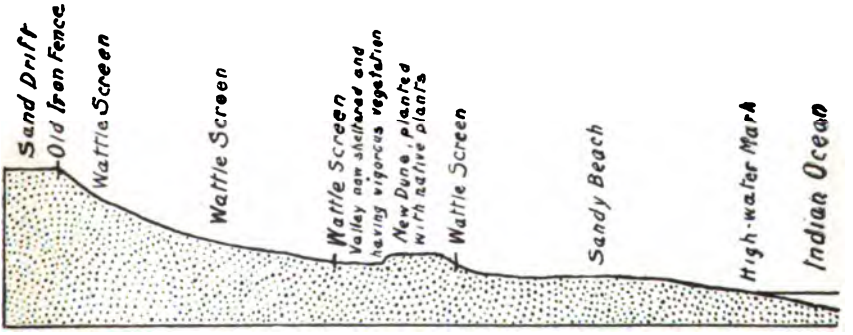
Sketch-plan showing where the natural bush-dunes have been broken through for streets, and where it is now necessary to erect protection works against sand-drift.

DURBAN BACK BEACH.





SAND-STAY SCREENS NEAR BEACH HOTEL, DURBAN.



SECTION OF SAME.

INDEX.

	Page	Figure
Abelia rupestris 304,	325	
Aberia caffra	323	
Abies 40, 43,	205	
Menziesii...	37	
pectinata 37,	205	
smithiana	205	
webbiana	205	
Absorption	69	
Abutilion	304	
Acacia 15, 27, 28, 36, 40, 43 92, 96, 126, 149,	303	
acuminata	352	
arabica	154	
baileyana	155	
binervata	154	
catechu	154	
cyclopis 110, 152, 303,	337	
dealbata 27, 48, 92, 101 126, 149,	154	
decurrens	149	
,, var normalis ...	149	
falcata	154	
farnesiana	155	
harpophylla...	154	
horrida	154	
implexa	154	
longifolia ... 110, 153,	323	
lophantha	253	
melanoxylon 27, 48, 66, 92 101, 110, 153, 246,	332	70, 73
mollissima 92, 99, 100, 101, 104, 110, 125, 126,	149	56
,, seed of 23, 27,	28	
polybotrya	154	
pycnantha	151	
retinoides 154,	329	
Acacia saligna 23, 110, 151, 152, 153, 302, 329,	337	
spectabilis 110,	155	76
white	247	
sp. Camel Thorn	155	88
Acajou-resin	262	
Acalypha	304	
Acer 27,	101	
dasycarpum	332	
Japanese species ...	304	
negundo	244	29
pseudoplatanus ... 27,	244	
saccharinum... ... 245,	332	
Achras sapota	253	
Acocanthera spectabilis ...	288	
Acorns 79,	242	
keeping qualities of 21, 23 24, 28,	242	
sowing 39, 79,	242	
Actinostrobus	221	
Adaptation to local circumstances	8	
Aeration of soil...	72	
Aesculus hippocastanum 13,	249	
Afforestation policy	342	
Afzelia australis	253	
Agathis alba...	201	
(Dammara) australis 107, 121,	200	37, 54
robusta	201	
Agave americana ... 314,	325	
variegata	315	
sisalana	315	
Agonis flexuosa	304	
Ailanthus glandulosa... ...	245	33, 55
imberbiflora	245	
Alberta magna	290	
Albizzia amara 251,	253	
fastigiata 111, 114, 251,	280	
julibrissin	253	
Leebek 251,	252	
lophantha	253	
procera 252,	329	
saman...	253	
Alder 249,	332	
Aleppo Pine 216,	323	34, 41
Aleurites triloba	251	47, 81
Alexandrian Laurel	259	
Algaroba 268,	272	
Algorobillo	260	
Allamanda	304	
Almond	27	
,, Indian	277	
Alnus glutinosa	249	
Aloe 298,	325	81, 69
American	315	
dichotoma	315	81
socatrina	315	69
Aloysia citriodora	304	
Altitude, effect of 76,	86	
Amaryllids	299	
Amasetole	283	
Amatungulu 110, 306, 323, 325, 335,	337	
American trees	238	
Ampelopsis quinquefolia...	317	
Vietchii 297,	317	
Amygdalus persica fl. pl.	304	
Ananas	315	76
Angophora intermedia ...	254	
lanceolata	254	
sub-velutina	254	
Antheraea cytheraea	213	
Apodytes dimidiata ... 280,	329	
Apple 24, 44, 48, 238, 250,	319	
Apple-scented Gum	192	
Apricot 27, 238,	319	
Aralia papyrifera	304	
Sieboldii	304	
Araucaria 15, 24, 101, 105, 117, 120, 121, 195,	303	
Bidwillii 196, 198, 203,	327	49
Brasiliensis 197, 200,	203	

	Page	Figure
columnaris	197	
Cookii...	197, 329	39, 41, 69
Cunninghamii ...	196, 197 199, 329	54, 74
excelsa	196, 198, 329	69
imbricata ...	195, 199, 200	
Rulei	200, 329	
Arbor-vitae	40, 110, 236, 321	41
Ardisia crenulata	304	
Areca	316	
Aristolochia...	317	
Arnatto-plant	257	
Artocarpus chaplasha	254	
hirsuta	253	
incisa	253	
integrifolia	253, 329	
Lakoocha	254	
Arundinaria tessellata ...	257	
Ash...	24, 27, 43, 91, 96, 101. 157, 247	
Manna	247	
Asparagus plumosus	296	
Aspen	241	
Aspidosperma Quebracho	124. 254	
Assam Rubber	113. 120 122. 123	39, 86
Assegai-wood	27, 281	
Atlas Cedar	219, 225	35
Aucuba japonica	304	
Australian experience	16	
Australian Myrtle...	324	
Red Cedar	108, 219	
trees	13, 91, 156	
Willow	151, 152	
Avicennia officinalis	303	
Avocado Pear...	110, 271	
Azalea indica	325	39, 69, 84
mollis	305	
Bald Cypress	232	40
Bamboo	102. 110, 117, 120, 257	84
Berg	257	
drawf	110, 257	81
propagation of...	258	
pots	33	
Bambusa	257, 326	
arundinacea	257, 258	
Balcooa	257	
Fortunei	110, 257, 259, 324	53, 81, 91
nigra	257	
spinosa	257	
vulgaris	257	84
Ban Oak	273	
Banana	101	
Wild...	337	
Banksian Rose...	297	
Banyan	114, 119	53
Baphia racemosa	288	49
Barbados Gooseberry	318, 323	
Barcelona-nut	250	
Barringtonia acutangula ...	329	
racemosa	59, 115, 289, 303	
Bastard Box-tree	180	
Cedar...	219, 233	
,, (Jamaica)...	220	
,, (Australia)	220	
Bauhinia ...	27, 101, 102, 256	
acuminata	256	
Bowkeri	256	
candicans	256	
Galpinii	256	33
Natalensis	256	
picta	256	
Petersiana	256	
purpurea	256	
tomentosa	256	
Vahlii	256, 317	
variegata	256	
Beaumontia grandiflora	305, 317	
Beds of transplants...		4
Beech	13, 91, 249	
Beefwood...	261	29, 32, 42
Belgaum Walnut	261	
Belhambra	272, 319	
Belis jaculifolia...	203	42
Berg Cypress	220, 322	
Bermuda Cedar	219, 227	41
Betula alba...	37, 249	
Beukenhout	282, 284	
Bignonia	27, 296	
jasminoides...	296	
other species	317	
Birch	37, 91, 249	
Bitter almond	286	
Bixa orellana	257, 305	
Black-butt	119, 172, 186	
Black Cypress	232	
Ironwood	27, 284	
Oak	242	
Pine	234	
Poplar	241	
Stinkwood	284	
Walnut	246, 333	39
Black Wattle	50, 87, 92, 99, 100, 104, 117, 303	56
bark analysis	354	
Coast unsuitable for ...	131	
Conditions suitable for	128	
Coppices...	144	
Cost of land	132	
Crop	146	
Drying	141	67
Drying sheds	142	60, 61, 62, 63
Economic farming ...	133	
Espacement...	137	
Felling	137	59
Market	149	
Packing	142	64
Pests	15, 145	
Preparation for sowing	133	
Profits	146, 149	
Prospects	147	
Proximity to market...	132	
Pruning	137	68
Regrowth	143	
Roads	137	
Seed	22, 27	
Seed per acre	137	
Seed collection...	145	
Shipment	143	
Soaking of seed	134	
Soil suitable for	129	

	Page	Figure
Sowing	136	
Task-work	140	
Thinning	137, 138	
Timber	143	
Blackwattle Industry	6, 125	
Industry abroad	127	
Blackwood	15, 27, 30, 48, 92, 101, 153, 246, 319	70, 73
(indigenous)	280	
Bloodwood tree	176	
Blue Gum	15, 18, 88, 92, 97, 101, 104, 107, 129, 156, 180	71, 72, 73
South Australian	181	
Blue Pine	217	
Blue Wattle.—See Silver Wattle.		
Bogabog	287	
Bogwood	284	
Botanic Gardens	16, 105, 195, 329	
in Cape Colony	294	
Bottle-brushes	305	
Bougainvillea	297, 317, 324	
Bouvardia	305	
Box Elder	244	29
Box-trees	185	
Bastard Box	180	
English Box	321	
Grey Box	159, 181	
Red Box	187	
Yellow Box	183	
Brachychiton	102	
acerifolium	274	
populneus	274	
Brachylaena	335	
Brazil Cherry	266, 308, 322	
Breadfruit tree	253	
Briar	325	
Bridal-wreath	307	
Bridelia micrantha	280	
Broom	309	
Spanish	314	
Brugmansia Knightii	305, 307	
Bruguiera gymnorhiza	303	
Brunfelsia	305	
Buddleya Lindlevana	305	
Madagascariensis	305, 318, 325	
Buds	40, 48	
Bunya-bunya	196	49
Burchellia capensis	290	
Butternut	246, 333	
Buxus sempervirens	321	
Cabbage-trees	288	
Cactus	315	
Caesalpinia coriaria	120, 260	47
pulcherrima	260	
other species	260	
Cajaput oil	270	
Calliandra Tweedii	305	
Callistemon	305	
Callitris (See Widdringtonia and Frenela)	220, 221, 234	
arborea	221	
australis (Frenela)	330	
calcarita	221, 234	
quadrivalvis	234	
rhomboidea (Frenela)	234, 319, 322, 329, 330	
robusta	234, 328	
verrucosa	329	
Whytei	221	42
Callus	41	15
Calodendron capense	238, 280, 330	
Calophyllum inophyllum	259, 330	
calaba	259	
Calpurnia	290, 305	
Cambuim layer	70	
Camdeboo Stinkwood	238, 249, 281	
Cameeldoorn	155	
Camelthorn	155	88
Camellia thea	306, 322	39
japonica	306	43, 84
Camphor-tree	24, 27, 124, 264	32, 43, 83
Canangium odoratum	259	
Canary Pine	217	41
Candlenut-tree	251	47, 81
Candlewood	282	
Canna	298	
Canopy	74, 82	
Cape Beech	283	
Cedar	221	
May	43, 332, 333	
Plane	284	
Capparis	290	
Care of plantations	62	
Carica papaya	315	
Carissa grandiflora	110, 290, 323, 335, 337	
Carnation	300, 306	
Carob	27, 37, 259	80
Carpinus betulus	250	
Carya	246	
alba	246, 333	
oliviformis	246, 333	
tomentosa	333	
Caryota	316	
Cassia fistula	260, 330	
florida	330	
Cassia-bark	264	
Cassipourea verticillata	289	
Castanea vesca	43, 249, 332	
Castanospermum australe	260	42
Castilloa	123	
Castor-oil plant	316	87
Casuarina	22, 37, 109, 120, 261,	
equisetifolia	120, 261, 303	
Fraseriana	261	
leptoclada	109, 261	29, 32, 42
quadrivalvis	120, 261	
stricta	48, 261	
suberosa	261	
tenuissima	261	
torulosa	261	48
Catalpa	43, 91, 101, 245	
bignonioides	13, 43, 245	32
speciosa	245	
Caucho	124	
Ceara Rubber	114, 118, 120, 122, 123	52

	Page	Figure
Cecropia peltata	261	46
Cedara Nursery		9, 10, 95, 96, 99
Cedar-boom...	219	
Cedars—(See also Pencil Cedars	219	
Atlas...	219, 225	35
Australian Red	108, 219, 262	
Bastard	233	
Cape...	221	
Deodar...	219, 221	35, 40
Incense...	235	
Japanese	235	75
Mlanji	221, 235	42
Mexican White	232	
Oregon	232	
Oregon Red	235	
Red	121, 219, 226	30, 70
White	232, 235	
Cedar of Goa	219, 230	29, 32, 38, 43
Cedar of Japan	219	75
Cedar of Lebanon ...	219, 224	
Cedarwood (Guiana)	220	
Cedar-woods	87, 89, 92, 108, 121, 219, 221, 262, 265	
Cedrela	108, 262	
australis ...	108, 219, 262	
fissilis	262	
odorata	108, 219, 262, 330	49, 55
toona	37, 108, 121, 219, 262, 330	
Cedro	219	
Cedrus	108, 121, 221	
Atlantica	219, 225	35
Deodara	24, 89, 92, 98, 101, 219, 221, 332	35, 40
,, varieties	224	
Libani	219, 224	
Celastrus peduncularis ...	280	
Celtis	238, 249	
australis	249, 330	
rhamnifolia...	281	
other species	249	
Cemeteries	295	
Central American Rubber	123	
Cephalotaxus	236	
Ceratonia saliqua...	27, 37, 259	80
Cereus	315	43
Cestrum laevigatum...	110, 306, 323	87
Ceylon Rubber culture ...	123	
Chaetachme aristata	330	
Chamaecyparis	228	
sphaeroidea...	219	
thurifera	219	
Chamaerops	316	
Chemical composition of plants	69	
Cheer Pine	89, 217	
Cherry...	47, 250	
double-flowered	313	
Cherimoyer	110	
Chestnut, Horse	249	
Moreton-Bay	260	42
Spanish	23, 24, 39, 43, 45, 249	
Wild	39, 280	
Chinese trees	14	
Chloroxylon swietenia ...	262	
Christmas tree	289, 312	
Christ's Thorn	308, 321	
Chrysanthemum	298, 299	
Chrysobalanus icaco	263	
Chrysophyllum cainito ...	263	
natalense	281	
Chusquea culeou	258	
Cider Gum	181	
Cinchona, species	263	
Cinnamomum camphora	124, 264, 330	32, 43, 83
cassia	264	69
Zeilanicum	264	
Cinnamon-tree	264	
Cissus discolor	318	
Citrus	110, 117	
Clanwilliam Cedar... ...	219, 234	
Clematis...	297	
Clerodendron...	289, 318	
Climatic conditions...	8, 13, 14, 29, 41	
Climbers	297	
Close-planting ...	12, 15, 63	
Cluster Pine (see Pinus pinaster)	215, 323	1, 29, 75, 84
Coast Districts	103	
Coast trees	120	
Cobaea scandens	318	
Cobnut	250	
Cocaine	265	
Coccoloba uvifera	265	
Cocoa-nut	112, 120, 316	53
Cocos	316	
flexuosa nucifera	112, 120, 316	54
plumosa	113	53
Codiaeum	307	53
Cola natalensis	281	
Colutea arborescens	306	
Collecting seed	21	
Combretum Kraussii	290	
Commercial treeplanting ...	15	
Commiphora.....	44, 238	
Comparative value of kinds	16	
Condensation of moisture ...	11	
Conifers	48, 303	
Convolvulus	297	
Coolibah	184	
Copal. West Indian	268	
Coprosma lucida	306	
Coral-tree...	307	
Cordia caffra	281	
Cordyline australis	316	
Cork oak	48, 91, 273	38
Cork-wood...	44, 238	
Corylus avellana...	250	
Cotoneaster Simmondsii	306, 323	
microphylla	306, 329	
Cottonwood..... ...	43, 44, 241	
Courbaril	124, 268	
Crape-flower...	318	

	Page	Figure
Crassula...	299	
Crataegus oxycantha fl. pl.	306, 324	
Creepers	297, 317	
Creosoted sleepers	19	
Crimson-flowered Gum... ...	179	
Crimson Oak	101	
Croton...	307	
Crown plantations	18, 346, 347, 348	
Crows Ash	267	
Cryptomeria japonica	58, 89, 92, 219, 235	
elegans	235	75
Cryptostegia madagascariensis	318	
Cultivation	79	
Cunninghamia sinensis	203	42
Cunonia capensis	281	
Cupressus	35, 40, 43, 58, 89, 108, 121, 221, 228, 303, 319, 321, 325, 326	
fragrans.....	219, 232	
fastigiata	229	
funebris ...	232, 321, 330	
glauca...	230	
horizontalis...	108, 121, 229	29, 69, 78
Lambertiana	231	
Lawsoniana	231, 321	
lusitanica...	108, 109, 121, 219, 230, 321	29, 32, 38, 43
macrocarpa	89, 108, 110, 230, 231, 321, 329	40, 51, 82, 83,
nootkatensis	219	
pendula-glauca	89, 92, 97, 101, 108, 230	32
pyramidalis	102, 229, 322, 329	31, 78
sempervirens ...	229, 330	
sinensis	220, 230	21
thurifera	219, 232	
thuyoides...	219, 232	
torulosa... ...	121, 230, 330	
Curraiong	274	39
Curtisia faginea...	27, 281	
Cussonia	288	
Cutch	154	
Custard Apple	110	
Cuttings	40	11 to 18
conditions necessary...	48	
disbudded	45	12
from roots	47	
from single buds	46	
from stools	44	
hardwood...	41, 42	11, 12, 14
softwood	41, 44	13
Truncheon	44	
Cycas	315	82
Cyclostemon argutus	281	
Cydonia japonica	307	
Cyperus	335, 356	
Cyphomandra betacea... ...	306	
Cypress. See Cupressus...	229	
Bald	232	40
Berg	220	
Black	232	
Himalayan	230	
Lawson	231	
Monterey	231	40, 82, 84
Montezuma	220, 233	
Portugese	230	29, 32, 38, 43,
scented	231	40, 82, 84
seed	26	
spreading		29, 69, 78
swamp	220, 232	40
upright	102, 229	31, 78
weeping	232	
white	232	
woods	219, 220, 221	
yellow	220	
Cypress Pine	220, 234	
Cytisus	307	
Dacrydium cupressinum ...	233	
Dahlia...	298, 299	
Dais cotinifolia	289	
Dalbergia miscolobium ...	265	
nigra	265	
sissoo	124, 265	
Dammara (Agathis) australis	107, 200, 330	37, 54
alba	330	
Damping off...	31	
Daphne indica	307	
Date Palm... ...	112, 118, 316	92
Datura Knightii	307	
Deciduous trees	14, 28, 29, 36, 37, 39, 56, 61, 81	
Deciduous trees, Chap. XVIII.	238	
Dendrocalamus	257	
strictus	257	
Den-tree	187	
Deodar Cedar	219, 221	35, 40
Desiccation extending	11	
Deutzia crenata	307, 325	
gracilis	307	
Dibber	29	3c
Difficult kinds to handle...	36	
Dipladenia	318	
Disbudded cuttings...	45	
Divi-divi	120, 260	47
Djatti	19	
Dog-plum...	44, 281	
Dolichadrone	275	
Dombeya	289	
Doorn-boom	154	
Dovyalis rhamnoides	289, 324	
rotundifolia	289	
Dracaena	316	
Drainage	67	
Drawn trees	26	
Drift-sand reclamation work	334	97, 98
Drought, effect of... ...	14, 78	
Drying-frame for seeds ...		2
Dumizulu	286	
Durable hardwoods	87, 90, 100	
Duranta Ellisii alba	307	
Plumieri	307, 325	
Dutchman's pipe	317	
Dysoxylon, species ...	220, 265	

	Page	Figure
Eastern slopes	83	
Ebony (Queensland)	256	
Economic advantage of tree planting	9	
Economic considerations 80,	82	
Effect of tree planting on climate	10	
Ehretia acuminata ... 307,	330	
Ekebergia	109	
capensis 44,	281	
Meyeri	330	
Elaeocarpus grandis	330	
Elaeodendron croceum... ...	281	
Elementary principles of Sylviculture	69	
Elm 14, 43, 91, 96,	245	
Emblic myrobolan	272	
Encephalartos	315	91
Eriobotrya japonica	271	36
Eriodendron aufractuosum	330	
Erythrina 27,	278	
acanthocarpa	307	
caffra 44,	288	51
Crus-gallii	307	
Humei	288	
latissima	44	
Zeyheri	288	
Erythroxylon coca ... 124,	265	
Escallonia floribunda 307,	325	
Espacement... ... ...66, 82,	190	
Essenhout 109,	287	
Eucalypts. Culture ... 167,	168	
espacement	170	
increment	214	
Fencing	171	
Planting out	170	
Remarks concerning species...	171	
Seed 22,	168	
Sowing...	169	
Sowing "in situ"... ...	170	
Transplanting	169	
Teasing	169	
Eucalypts 15, 16, 17, 20, 28, 29, 31, 36, 40, 43, 63, 65, 96, 101, 117, 119, 121, 167, 303		
Eucalyptus oil	348	
Eucalyptus acmenioides 171,	330	
amygdalina 90, 119, 172,	332	
angustissima ... 173,	303	
botryoides 173,	191	
baileyana	175	
bicolor	332	
calophylla ... 86, 173,	305	40
capitellata... 90,	174	
citriodora... 28, 30, 51, 90, 107, 119, 171,	174	73
coriacea 90, 175,	186	
cornuta... ... 175, 330,	352	
corymbosa 90, 108, 176,	332	
corynocalyx... 90, 171,	176	
crebra ... 90, 107, 121,	177	
diversicolor 30, 90, 108, 119, 171, 178, 214,	303	72
eugenioides 175,	179	
ficifolia ... 171, 179,	303	
globulus 15, 18, 28, 90, 97, 101, 104, 129, 156,	180	72, 73
timber, value of	157	
Logs being shipped ...		71
Tasmanian estimate ...	157	
,, conservation...	163	
durability	159	
Official experience of...	160	
working qualities of...	161	
technical uses...	162	
maturity	163	
yield	214	
gomphocephala ... 120, 303,	180, 337	
goniocalyx 90,	180	
Gunnii ... ... 90 ,171,	181	
hemiphloia 90, 91, 181,	185	
Lehmannii	324	
leucoxylon... 90, 156, 171, 181, 188, 192,	330	
longifolia	182	
loxiphleba	352	
macrorhyncha 51, 90, 175,	182	
maculata 90, 119,	182	
marginata 13, 86, 90, 171, 178,	183	
melliodora	183, 185	
microcorys ... 90, 108,	183	
microtheca 119,	184	
obliqua... 90, 175, 184,	332	
obtusifolia	332	
occidentalis 185,	351	100, 101
odorata 90,	185	
paniculata ... 91, 107, 121, 177, 186,	332	
pauciflora... 186,	193	
pilularis 90, 119, 172,	186	
piperita	187	
polyanthema	187	
punctata 90,	188	
redunca...	352	
resinifera	188	
robusta 107, 119, 189, 303,	332	73
rostrata 30, 90, 91, 108, 119, 157,	189	33 72, 73
saligna 90, 108, 119, 156, 159,	191	
salubris	352	
siderophloia 90, 177, 188, 191,	332	
sideroxylon 90, 91, 107, 121, 177, 182, 192,	303	
stuartiana ... 90, 101,	192	
tereticornis 90, 91, 108, 119, 156, 193, 330,	331	
viminalis 90, 172, 173, 193,	330	
Engenia brasiliensis... 266,	308, 322	
capensis...	335	
cordata 103, 266,	282	
eucalyptoides 266,	308	

	Page	Figure
jambolana	266	
jambos	266	
mimi...	308	
Zeyheri...	282	
Euonymus japonicus... 308,	325	
latifoluis... 308,	325	
Euphorbia	316	76
jacquiniflora	308	
splendens 308,	321	76
European trees 91,	238	
Evergreen oak	37	
Evergreen trees, requirements of	238	
Excaecaria Agollacha	266	
africana...	282	
sebifera 266,	330	
Exhalation	69	
Fabricia laevigata ... 308,	324	
Fagus silvatica 13	249	
Fan Palm		90
Faurea saligna... 282,	284	
Felling	67	
Fencing 55,	63	
Ficus ... 44, 46, 47, 101, 114, 119,	320	16
elastica ... 113, 117, 118, 119, 120, 122,	123	39, 86
,, variegata	308	
indica 114,	119	53
macrophylla	120	
microphylla	297	
Mpai ... 44, 114, 119,	320	89
,, analysis of ...	124	
Parcellii 114,	308	
religiosa	120	
repens 308,	318	
Uluzi	320	87
Fig... ... ... 44, 119,	250	
Wild 109,	326	87, 89
Filbert	250	
Fire	38	
Firebelts 63,	279	
Flamboyant... ... 114, 272,	320	52, 55, 90
Flame-tree 114,	274	
Flat-crown 103, 109, 111, 114, 118,	253, 280	
Flindersia australis ... 124,	267	
bennettiana...	267	
oxleyana	267	
Forest planting	18	
Forest policy of Government	339	
Forest Red Gum	193	
Forests and Moisture 10, 75,	96	
Fourcroya	325	
Franciscea	308	
Fraxinus ... 27, 43, 101,	247	
excelsior...	247	
ornus	247	
Frenela (see Callitris) 110, 220,	234	
australis	330	
rhomboidea	330	
Fresh seeds	21	82
Frost, Effects of ... 14, 92,	279	
Fruit-trees ... 12, 14, 15,	298, 319	
Fuchsia 308,	309	
Fusanus	274	
Galphimia nitida	309	
Garcinia mangostana	267	
cochin-chinensis	267	53
Gardenia florida	309	
globosa 290,	309	
Neuberia	290	
Rothmannia 282,	290	
Gazania	336	
Genista scoparia	309	
Giant Gum	172	
Gingko biloba 13,	236	
Gladioli	299	
Gleditschia triacanthos 29, 43, 91, 101,	247	
Glyptostrobus	221	
Golden Shower	317	
Gooseberry, Barbadoes 45,	323	
Gorse	314	
Government action in tree-planting	340	
Government aid in Cape Colony	295	
Government Nursery, Cedara 346,	347	9, 10, 95, 96, 99
Empangeni	348	
Winkle Spruit	348	
Government Wattle Plantations	348	
Grafts 40,	48	
Grape-vine... 41,	46	17
Grass, for garden sole ...	328	
Grass-burning	11	
Grazing	64	
Grenadilla	318	
Grevillea Caleyii ... 267,	309	42
Fosteri	267	
Hilleana...	267	42
robusta... 22, 91, 109, 110, 124, 267,	330	33, 90
Grewia	290	
Grey-box 159,	181	
Grey Ironbark...	186	
Greyia Sutherlandi...	289	
Guaiacum officinale ... 267,	330	
Guava 110, 272,	319	
Mountain	273	81
Guazuma, sp.	220	
Gums.—See Eucalypts.		
Habrothamnus aurantiacus	309	
cyaneus	309	
elegans	309	
Hack-berry	249	
Haematoxylon campechianum	268	
Hakea	309	
linearis 28,	324	
suavolens	37	
Halleria elliptica... ... 282,	323	
Hamelia chrysantha	309	
Hancornia speciosa...	268	

	Page	Figure
Hard Pear	109, 287	
Hard-wood cuttings	41	11, 12, 14
Hardwoods	83	
durable	87, 90	
non-durable	87, 90	
Harpephyllum caffrum	44, 282	
Hawthorn ... 24, 27, 48,	91, 306, 324	
Hazel	250	
Heaths	298	
Hedges and Shelterbelts (Chap. XXIII.) ...	110, 321	
Heel.		14
Height of trees...	329	
Hereditary traits	23	
Heretiera Fomes	330	
macrophylla...	330	
Heteromorpha	44	
Hevea brasiliensis ...	23, 123	
Hibiscus...	43, 325	
Patersonii	268	
schizopetalus	310	
sinensis	309	
syriacus	309	
tiliaceus 23, 44, 114,	288, 320	85
varieties	310	
Hickory ... 24, 191, 246,	333	
Himalayan Cypress	230	
Holes for tree-planting ...	55	
Holly 91, 324,	329	
Holm Oak	273	
Holmskioldia sanguinea	310, 318	
Honey-locust	247	
Honeysuckle 311,	318	
Hornbean	250	
Horse-chestnut ... 13, 91,	249	
Horticultural Societies ...	301	
Horticulture, Urban and Suburban (Chap. XXI.)	291	
Horticulture (Chap. XXIV.)	327	
House-building material ...	121	
Humus 68, 73, 80,	98	
Hydrangea hortensis	310	
paniculata	310	
Hymenaea courbaril 124,	268, 330	
Hyphaene crinita 111, 113, 124,	202, 316	
Ibungu 122,	283	
Icaca altissima	220	
Igqwanxe	284	
Ilala 111, 113,	202, 316	
Ilang-ilang	259	
Ilex-aquifolium 324,	329	
capensis	283	
Imfeyenkomo	283	
Inarching	48	
Incense Cedar	235	
Indian Almond	277	
Indian Cedar... 219,	221	
Indian Trees 13,	120	
India Rubber Tree (Ficus elastica)		39, 86
Indigenous tree (Chap. XX.)	278	
Indigenous trees 92, 111,	117, 119	
Ink-berry 306,	323	
Intlungu-nyembe	288	
Ipomaea 335,	336	
Iqumzu	286	
elinameva	286	
Irids	299	
Ironbark ... 121, 159, 177,	183, 191, 192	
Broadleaved	191	
Grey	186	
Narrow-leaved...	177	
Red	192	
White	186	
Ironwood 179,	191	
Black	284	
Kafir	283	
White	287	
Irrigation... ... 14, 68, 77,	82	
Isiduli	282	
Isifiti	288	49
Isifuce...	286	47
Isiquane	284	
Isiquane-we-hlati... ... 283,	284	
Itwyina	286	
Ivy, English	297	
Ixora	310	
Jacaranda mimosaefolia,	114, 268, 330	52
Jacaranda-wood	265	
Jack 110,	253	
Jamin	266	
Japan Quince	307	
Japan varnish	274	
Japanese Cedar	235	
Ivy	317	
Trees	14	
Virginian Creeper	297, 317	
Jarrah 13, 19, 86, 90, 107,	161, 179, 183	
Jasminium 290, 310,	318	
Jatropha multifida...	310	
Jessamine	297	
Jhand	272	
Juglans cinerea 246,	335	
nigra 246,	333	39
other species	246	
Jujube	277	
Juniper 27, 221,	321	
Juniperus 225,	326	
barbadensis...	226	
Bermudiana... 24, 108, 121,	219, 227, 322, 330	41
cedrus... 219,	228	
mexicana	219	
oblongata... 228,	330	
virginiana 24, 97, 108, 109,	110, 121, 219, 226, 322, 329, 330, 332	30, 70
other species...	228	
Justicia	310	
Kaffir-boom 44, 238, 288,	319	51
Kaffir-plum 44,	282	

	Page	Figure
Karri 19, 108, 119, 178,	214, 303	72
Kauri Pine 107, 121, 163,	195, 200	37, 54
(Queensland)	201	
Kauri Gum	202	
Kei-apple...	323	
Kerria japonica	310	
japonica variegata ...	310	
Kersenhout...	286	
Kigelia pinnata...	290	
Kiggelaria dregeana	283	
Kinderbesje	282	
Knob-wood	287	
Lagerstroemia indica 310,	325	
reginae... 310,	330	
Lagunaria Patersonii 23,	268	82
Landolphia florida	122	
Kirkii 114, 122,	283	
Kirkii, analysis of ...	124	
Landscape gardening	12	
Larch ... 13, 28, 37, 91,	236, 332	
Himalayan	236	
Japanese	236	
Larix Europea (see Larch)		
Griffithii	236	
leptolepis	236	
Lasiandra macrantha	311	
Lasiosiphon	290	
Latania	316	
Latitude, effect of	76	
Laurel, Alexandrian	259	
Lauristinus	314	
Lawson Cypress	231	
Layers...	46	19, 20
Layering high branches ...	47	
Leather-jacket	188	
Lemon-scented Gum... 107,	174	73
Lemon-wood 67,	287	
Leptospermum laevigatum	324	
Leucadendron argenteum	268, 311	
Leveller...		3
Libocedrus decurrens 219,	221, 235	
other species	235	
Lignum-vitae	267	
Ligustrum lucidum ... 311,	322	
japonicum... 311,	322	
Lilac	314	
Liliaceae	299	
Lime-tree 13,	91	
Limnoria	161	
Linden...	250	
Liquid manure	29	
Liquidamber stryaciflua	247, 330	
Liriodendron 27, 91, 101,	243	32, 79, 82
Litchi 110, 118, 124,	271	81
Litsaea sebifera...	268	
chinensis	268	
Livistona	316	
Logwood	268	
Lombardy Poplar 43, 44, 101,	102, 241, 319, 325	32
Longan	271	
Lonicera caprifolium 311,	318	
Loquat 13, 110,	271	36
Lotus-tree	249	
Loxopterygium Lorentzii 124,	256, 269	
Loxostylis alata	269	
Lysiloma sabicu	330	
Maba natalensis	289	
Macademia ternifolia	330	
Macaranga capenses	288	
Machaerium	269	
Mackapa Bella	311	
Macluria aurantiaca 247,	324	78
Macrozamia	315	
Magnolia 47, 101, 102, 269,	311	
Campbellii	269	
hypoleuca	269	
grandiflora	269	82
Mahogany... 275,	276	
Mountain	257	
Natal 109,	287	44
Red...	188	
Swamp 107, 119, 189,	303	
Mallet-bark..... 148,	185	
Chapter XXVII.	351	100, 101
analysis of	353	
Mandevillea 297,	318	
Mangaihas	263	
Mangifera indica 269,	330	76, 81
Mango 47, 110, 118,	269	76, 81
Mangosteen	110	
Mangroves 59, 103, 115, 120,	303	
Manihot Glaziovi 114, 118,	122	52
Manna Ash	247	
Gum...	193	
Manure	29	
Maple 27, 43, 48, 91, 244,	245	
Birds-eye	198	
Sugar 245,	332	
White	332	
Mappa	288	
Maputaland conditions... ...	17	
Maram-grass...	336	
May (English)	324	
(Cape) 314,	323	
Medinilla magnifica	311	
Mediterranean trees	14	
Melaleuca	311	
genistifolia	330	
leucadendron	270	
squarrosa	270	
Melia azaderach 248,	326	
azaderachta	330	
Indica	248	
Mesembryanthemum ...298,	336	
Mesquit Bean...	272	
Mexican White Cedar 219,	232	
Meyenia erecta	311	
Michelia champaka...	270	
Midlands. Treeplanting in	118	
Milkwood	109	
Red ... 270, 283, 286,	335	
Millettia caffra 283,	330	
Sutherlandii	289	

	Page	Figure
Mimi	308	
Mimosa rubicaulis	270	55
Mimusops caffra 270,	335	
obovata 283,	331	
other species	270	
Mist-belts 11, 85,	118	
Miscellaneous Trees (Chap. XIX.)	251	
Mixed planting... 14,	66	
Mkanga	133	
Mkuhlu ... 109, 111, 117,	287	43
Mlanji Cedar ... 221, 235,	322	42
Monkey-puzzle	199	
Monterey Cypress	231	40, 51, 82, 83
Montezuma Cypress ... 220,	233	
Moonflower 305,	307	
Moreton-bay Fig	119	
Moreton Bay Chestnut ...	260	42
Moreton Bay Pine	197	54, 74
Morus alba ... 43, 101, 248,	324	
other species... ... 248,	249	
Moulmein Cedar	219	
Mountain Mahogany	257	
Mpai 44, 114, 119,	320	89
Mulberry, White 43, 248,	319	
Chinese 248,	324	
Black	248	
Municipal Horticulture ...	293	
Murraya exotica...	311	
Musa paradisae	316	
Musaenda frondosa	311	
erythrophylla	312	
Myoporum insulare...	271	
laetum	271	
Myristica, species ... 270,	271	
Myrobolans 124,	276	54
Emblic	272	
Myrsine melanophleos... ...	283	
Myrtle 312,	322	
Australian...	324	
Myrtus communis ... 312,	322	
Nandina domestica	312	
Nasturtium	297	
Natal Mahogany 109, 111, 117,	287	43
Natural factors of tree growth	81	
Neem	248	
Negundo aceroides...	244	29
Nephelium lappaceum ...	271	
Litchi... 124,	271	81
Longanum	271	
Nerium oleander	312	
New soil	59	
New Zealand Trees...	13	
Niebuhria triphylla	290	
Non-durable hardwoods 87,	90, 92, 100	
Norfolk Island Pine	198	69
North American Trees ...	91	
Northern White Cedar 219,	236	
Norway Spruce	205	
Ntombe	44	
Number of seeds to sow...	26	
Nutmegs	270	
Nuxia, species	284	
Oak, British ... 14, 15, 37, 91, 101, 157, 178, 241,	319	31
Ban	273	
Black...	242	
Cork	273	38
Holm	273	
Scarlet	242	
White	273	
Valonia...	273	
Oak-bark	254	
Oak, Increment of	254	
Ocotea bullata	284	
Ochna arborea	284	
atropurpurea	290	
Odina caffra	282	
Olea laurifolia 27, 179, 191,	284	
verrucosa	284	
Oleander 311,	324	
Olinia cymosa	284	
Olive 27,	91	
Opuntia 315,	325	
Orange	13	
Oregon Cedar 219,	232	
Oregon Red Cedar	235	
Oreodaphne bullata	284	
Oreodoxa regia	316	93
Ornamental trees 50,	100	
Ornamental trees and shrubs (Chap. XXII.)	302	
Osage Orange 247,	324	78
Osier 43, 240,	324	
Outeniqua Yellowwood ...	236	
Owenia acidula 271,	331	
venosa	271	
Oyster Bay Pine 234,	322	82
Palixander-wood 265,	268	
Palms 111, 112, 124,	316	53, 54, 90, 92, 93, &c.
Panax Gerrardi 290,	311	
Pandanus utilis...	113	54, 55, 91
Pansy...	300	
Papaw 110,	315	
Papilio demoleus	280	
Para Rubber	123	
Passiflora...	318	
Passion-flower	318	
Paulownia imperialis	271	
Pavetta... 289,	312	
Peach... ... ... 43, 238,	250	
double-flowering	312	
Pear...24, 44, 47, 238, 250,	319	
Pecan-nut... 246,	333	
Peddiea africana	289	
Pelargonium...	298	
Pencil Cedar 97, 108, 219,	226	30
of Bermuda...	227	41
Australian 220,	265	49, 55
Pentas carnea	312	
Peppermint	172	
Peppermint, Stringy-bark...	187	
Pepper-tree ... 21, 36, 37,	274	
Pereskea aculeata ... 318,	323	
Persea, species	271	

	Page	Figure
Persimmon	110	
Pests 14, 15, 44, 145, 200, 213, 280, 294, 298		
Petraea volubilis	312, 318	
Philadelphus... ...43, 312	325	84
Phoenix	316	
dactylifera	112	92
reclinata	111	54, 82
Photinia eriobotrya	271	36
Phyllanthus emblica... 272,	331	
Phyllostachys	257	
Phytolacca dioica	272	
Picea excelsa	205	
abies...	225	
Pines 15, 17 28, 35, 40, 43, 58, 65, 90, 96, 98, 121,	204	
Pine cones and seeds 22, 27, 28		1
Pine Timber... ... 99, 120,	204	
Pine Aleppo	216	34, 41
Black	234	
Blue...	217	41
Canary	217	
Cheer	217	
Cluster...	215	29, 75, 84
Cypress	234	
Insignis	206	75, 77, 78
Oyster-Bay 234,	322	82
Pitch 217,	218	42
Red	233	
Scotch... ... 13, 28, 37,	217	29
Stone 66,	216	75
Weymouth	217	
Pinus 40, 43,	205	
abies	13	
australis 89, 106, 121, 217,	331	42, 43
Austriaca	332	
Balfouriana...	218	
Benthamiana	331	
Canariensis ... 89, 99, 106, 121, 217,	332	41
corsica	332	
Pinus, excelsa 13, 89, 106,	217, 223	
halepensis 38, 51, 66, 81, 89, 92, 97, 99, 106, 109, 121, 216, 323, 329,	331	34, 41
insignis 15, 29, 86, 88, 92, 96, 98, 99, 104, 106, 121, 205, 206,	332	75, 77, 78
,, Mr. Schopflin's report on	206	
,, increment	214	
longifolia 89, 99, 106, 217,	222	
maritima 106,	331	
Massoniana...	218	70
palustris (see P. australis) 106,	331	
picea	13	
pinaster 37, 65, 81, 89, 92, 98, 99, 106, 121, 152, 204, 215,	323	29, 75, 84
,, cones of		1
,, increment...	214	
pinea 65,	216	75
ponderosa	218	
rigida...	218	
radiata (see P. insignis)	212	
sabiniana	218	
sinensis 218,	331	
strobus 13,	217	
silvestris 13, 37,	217	29
Pitch pine 217,	218	42, 43
Pithecolobium	251	
Saman	253	
Pittosporum tobira	312	
Plane ...14, 37, 43, 45, 46, 91, 96, 101,	243	
American	243	
Plantain...	325	
Planting of trees 50,	56	
Planting chain 55,	56	25
Planting out 31,	32	6d
Platanus occidentalis... 43,	243	
Platymiscium polystachyum	331	
Plectronia	285	
Plum ... 27, 47, 239, 250,	319	
Plumbago capensis ... 290, 318,	312, 323	
Podocarpus 27, 58, 101, 113,	236	
elongata 236,	285	
pungens	331	
Thunbergii... 236, 285,	331	86
,, falcata ... 236,	285	94
Totara	236	
Poinciana aurea 272,	313	
pulcherrima...	260	
regia 114, 272,	320	52, 55, 90
Poinsettia pulcherrima ...	313	
Polygala	290	
Pomegranate 43, 110, 313,	321	
Poplar ... 37, 91, 101, 240,	319	
Black	241	
Cottonwood	241	
Lombardy	241	32
tulip	243	32, 79, 82
white 47,	240	
Poplar timber	243	
Populus Alba	240	
canadensis	241	
fastigiata 43, 44, 102, 241,	325	32
monilifera ... 43, 44,	241	
nigra	241	
Port Jackson Willow	151	
Portugese Cypress	230	29, 32, 38, 43
Portulacaria Afra ... 313,	323	
Prainea	317	
Preparation of soil...	52	
Preserving seeds	23	
Pricking out transplants ...	28	
Prickly Pear... 315,	325	
Pride of India	310	
Prizes for Treeplanting ...	348	
Principles of Sylviculture...	69	
Privet... ... ... 48, 43, 110,	311	
Chinese	322	
Japanese	322	
Propagation of trees by means of cuttings... ...	40	11, 15
Propagating house	49	
Prosopis, species	272	

	Page	Figure
Protea 109, 284,	290	
Proteaceae 268, 284,	298	
Pruning 65,	220	21
Prunus cerasus fl. pl.... ...	313	
Pissardii 101,	313	
Psidium Guayava	272	81
Ptaeroxylon utile...22, 238,	286	
Pterocelastrus variabilis ...	286	
Puddling roots...	35	
Pulp-making	241	
Punica granatum... ... 313,	322	
Pure planting	14	
Purple Plum	101	
Purpose of planting	50	
Pygeum africanum	286	
Quebracho... 124,	148	
Red...	254	
Colorado ... 124, 254,	269	
Queensland Kauri	201	
Ebony	256	
Quercus aegilops	273	
alba	273	
coccinea 101,	242	
ilex 37,	273	
incana... 273,	331	
pedunculata	241	31
rubor	241	
suber 48,	273	38
Quince 24, 43, 48,	324	
Japanese 48,	307	
Quinine	263	
Qwar	285	
Railage	99	
Rainfall	76	
Raising young trees from seed	21	
Rambutan	271	
Rancouran	271	
Raphiolepis indica...	313	
Rasp	48	
Raspberry-jam...	352	
Ravenella Madagascariensis	316	76
Red-berry...	284	
Red-Box	187	
Red Cedar... ... 121, 219,	226	30
Australian... 108, 219,	262	49, 55
Oregon	235	
Red Currant	286	
Red Els	281	
Red Gum 159,	189	33, 72, 73
of West Australia ...	173	40
Forest	193	
Red Ivory	287	
Red Mahogany	188	
Red Milkwood ... 270, 283,	335	
Red Oregon Cedar	219	
Red Pear	286	
Red Pine	233	
Redwood 219,	233	
indigenous	284	
Regrowth	68	
Reserved Trees	280	
Rhizophora mucronata 120,	303	
Rhus coriaria	273	
laevigata	286	
longifolia	286	47
rhodanthema	219	
vernicifera	274	43
Rhynchospermum jasminoides	318	
Ricinus communis	316	87
Ridge and furrrow planting	59	26, 27
Roads	65	
Robinia... 26, 43, 91, 101,	247	
Rocky sites	54	
Rondeletia speciosa 313		
Roodeblad	290	
Root-cuttings	48	18
Root development	52	15, 22
Root pruning seedlings 31,	35	5h
Rose-apple	266	
Roses 297, 298, 299, 313, 318,	325	
Banksian ... 297, 318,	325	
Briar...	325	
Crimson Cluster	318	
Maccartney 318,	325	
Microphylla	325	
Tea	297	
other kinds	299	
Rubber 114,	122	
Vine...	283	
Cecropia	261	46
Hancornia	268	
Culture in Ceylon ...	123	
Assam (See Assam Rubber)		39, 86
Central American (See Castilloa)		
Para (See Para Rubber)...		
Sabal	316	
Saffron-wood	281	
Sal 124, 223, 265,	274	
Sale of transplants	346	
Salisburia adiantifolia 13,	236	
Salix	120	
Babylonica 43, 44, 102,	238	31
viminalis	43	
other species ... 239,	240	
Sambucus	314	
Sample area measurement	285	
Sand reclamation work ...	334	97, 98
Sandal-wood 274,	352	
Santalum album ... 274,	331	
Cygnorum	352	
Santal-oil	274	
Sapindus emarginatus	274	
longifolius	274	
Sapodilla Plum	253	
Satinwood 198,	262	
Saturation, effects of... ...	293	
Satyobe	284	
Scarlet Oak...	242	
Scavaeola... 335,	336	
Scented Cypress	231	40, 82
Schinus molle 21, 36, 37,	274	
Schotia brachypetala	289	
Schrebera alata	289	
Sclerocarya caffra	288	
Scolopia Mundtii	286	
Zeyheri	286	
Scotch Pine ... 13, 27, 36,	217	29

	Page	Figure
Screens for seed-beds	25	4, 8
Screw-pine	113	55, 91
Scutia commersoonii	336	
Seaforthia	316	
Season for sowing seed ...	28	
Seeds...	21 to 28	1
Seed-drying frame	22	2
Seeds in open beds	33	
Seedlings	29	5, 6
Seedlings, Advantage of ...	15	
Seedling-houses	26	8
Selection by roots	71	
Senecio juniperina	133	
Septee	281	
Sequoia	58, 221	
Sempervirens	89, 219, 233	
Wellingtonia	234	
Shade-bearers...	67, 279	
Shading seedlings	25, 31	4
She-oak	261	
Shelter trees and belts	51, 109, 325	
Shelter belts	322, 325	
Shipments of Wattle Bark	126, 127	
Shorea robusta	124, 274	
Shortening roots of seedlings		7
Sideroxylon inerme	286	
Silk-Oak or Silky Oak	22, 109, 124, 267	
Silver Fir	13, 205	
Silver Tree	268, 311	
Silver Wattle ...	27, 48, 92, 101, 126, 149	
Singapore Cedar	219	
Siris, White and Pink	252, 253	
Sisal Hemp	315	
Sisu, or Sissoo	124, 265	
Site for a Plantation	52	
Size to plant	55, 59	28
Skadiopitys...	221	
Sleepers ...	19, 107, 121, 165	
Bonusn	348	
sizes of	19	
Prices of	19	
Sneezewood	16, 22, 163, 238, 286	
Sneezewood poles	44, 240	
Snowball-bush	314	
Soft-woods	87, 88	
Soft-wood cuttings...	45	13
Soil	28, 76, 87	
Soil for cuttings	41	
Solanum Wendlandii	318	
Sour Plum	271	
Sowing in situ	37, 79	
Sowing seeds	24	
Sowing in lines	38, 39	
Spanish Broom...	314	
Spanish Chestnut	43, 44, 45, 91	
Spartium junceum	314	
Spathodea campanulata ...	275	
Rheedii	275	45, 93
Speciosa	114, 275	
Specimen Trees	12, 59, 303, 328	
Spekboom	312, 323	
Spekhout	283	
Spiraea prunifolia ...	314, 323	
Spotted Gum	182	
Springs	98	
Spruce ...	13, 28, 91, 205, 223	
Spruce Fir	225	
Stapelia	299	69
Star-apple	263	
State forestry	6	
Stenocarpus salignus	331	
sinatus	331	
Stephanotis floribunda ...	318	
Sterculia alata	275	46
acerifolia	274, 331	
diversifolia	23, 274	39
rupestre	275	
Stinkwood, Black	284	
Camdeboo...	238, 249, 281	
Stone Pine...	66, 216	
Stratified seed	23	
Street trees...	319	
Strelitzia augusta ...	111, 316, 337	
Stringy-bark ...	163, 174, 175, 182	90
Peppermint	187	
Tasmanian	184	
Victorian	182	
White	179	
Strychnos Henningsii	287	
Subsoil	76	
Suburban Horticulture ...	291	
Suckers	47	
Sugar-bush	109	
Sugar Gum	176	
Sugar Maple	245	
Sumach	273	
Swamp Cypress	124, 220, 232	40
Swamp Mahogany	107, 119, 189, 303	73
Swamp trees ...	107, 119, 129	
Swamp, Method of planting		27
Sweet-gum tree	247	
Swietenia Mahogani	275, 331	
macrophylla	276	
Sycamore... ...	27, 91, 96, 244	
Sylvicultural factors of tree growth...	81	
Symbiosis	71	
Syncarpia laurifolia ...	91, 124, 275	
Syringa vulgaris	314	
Syringa-tree	248	
Tabernaemontana coriaria	314	
ventricosa	287	
Tallow-tree	266	
Tallow-wood	108, 183	
Tamarind	124, 276	
Tamarindus indica	124, 276, 331	
Tamarisk	43, 276	
Tamarix gallica	43, 276	
Tap-root	36	
Tarchonanthus camphoratus	288	51
Tasmanian Blue Gum ...	180	

	Page	Figure
Taxodium	221	
distychum 89, 124.	220. 232, 332	40
mucronatum... ...	220, 233	
sempervirens	233	
Taxonia	319	
Taxus	236, 324, 329	
Tea	110, 306, 322	39
Teak... 89, 109, 121, 223,	276	49
New South Wales ...	267	
Teasing...	35, 78	
Technical training ...	7, 8	
Tecoma australis	319	
capensis ... 290, 319,	323	
grandiflora	317	
Mackenii	319	
radicans	317	
ricasoliana	319	
stans	314	
Tectona grandis 109, 121,	276	49
Hamiltoniana ...	276, 331	
Temperature	75	
Terblanz	282	
Teredo	161	
Terminalia Arjuna ...	276, 331	
Bellerica	124, 277	54
Catappa... ...	120, 276, 331	45
Chebula...	276	
tomentosa	276	
Termites	145	
Test-grounds	16, 119	
Tetraclinis	221	
Thinning...	74	
Thivetia neriifolia	314	
Thorn Pear...	286	
Thorn-veldt	131, 155	
Thuya dolobrata	236	
compacta	236	33
gigantea 219, 220, 235,	331	
Lobbii	235	29
occidentalis	219, 236	
orientalis	236, 321	41
Thuyopsis dolobrata	236	
Tilia europea...	13, 250	
Tillage, Effect of	72	
Timber exports from Australia	19	
Timber imports into Australia	18	
Timber imports into Natal	5, 18, 344	
Timber of Blue Gum... ...	156	
Timber production	50	
Tin-punching machine ...	25	3
Tins...	24, 32. 33, 59	3, 6, 24
Toddalia lancelata ...	287, 331	
Tooart	180	
Toon	89, 108, 121, 262	
Torr-vale Gum	107, 121, 186, 332	
Totara	236	
Toxicophlaea	288	
Transplanting	29	
preparation for ...	31, 35	5, 7
Transplants	31	4, 5, 6, 28
Transvaal as a market ...	6	
Tree-guards	55	23
Treeplanting in the Coast Districts	103	
in the Midlands	118	
in the Upper Districts	83	
in Zululand	116	
Trees in separate tins ...	32	
Tree Tomato	306	
Trellis-plants	296	
Trichilia emetica 109, 111,	117, 287	43
Trimmed trees	329	
Tristania conferta 91, 277,	331	
Tropaeolum	297	
Tropical and Subtropical kinds	13, 17	
Trumpet climber	317	
Trumpet-tree	261	46
Truncheon cuttings	44	
Tulip poplar...	243	
Tulip-wood	243	
Tulip-tree	91, 243	32, 79, 82
Tungwane	281	
Turpentine, Production of	216	
Turpentine tree	124, 275	
Turraea heterophylla	289	
obtusifolia	289	
Ubu-hlungu benyoka	288	
Uhdea bipinnatifida	314	
Ulex europea	314	
Ulmus americana	332	
campestris	43, 245	
Uluzi	44, 59, 109, 320	87
Umbaba	280	
Umbinza	282, 321	
Umbomyane...	281	
Umbo-nemfene	285	
Umdakana	280	
Umdoni...	103, 266, 282	
Umdubu	290	
Umdumu	283	
Umgani	288	
Umgwenye	282	
Umgweny-uizenja	281	
Umgxina	281	
Umhlagella	281	
Umhlahlomakwabe	280	
Umhlakoti	286	
Umhlandoti...	280	
Umhlazane	284	
Umkobess	284	
Umkobo	285	
Umkuhlu...	287	44
Umlolwa ...	44, 114, 288, 320	85
Umnini	287	
Umnonono	287	
Umnovunovu	281	
Umnqai	280	
Umnquashube	281	
Umnungu-mabele	287	
Umnyezane	289	
Umpafa	288	50
Umquasqu	284	
Umquashu	286	
Umqumu	284	
Umqwaqwana	289	
Umsinga...	288	

	Page	Figure
Umsinsi	288	51
Umsunti	285	
Umswi	282	
Umtati	286	
Umtelele	284	
Umtenenenda	281	
Umtomboti	282	
Umtozane	289	
Umtunzi...	283	
Umvumvu	281	
Umxamo	289	
Umzimbeet 27, 109, 118, 123, 283		
Upper Districts	17	
Upright Cypress... ... 102,	229	31, 78
Urban and Suburban Horticulture (Chap. XXI.)...	291	
Uvetu	287	
Valonia Oak	273	
Varieties	40	
propagation of...	40	
Vegetable Ivory	113	
Veronica Hendersoni	314	
Viburnum opulus...	314	
tinus...	314	
Vine arbour...	297	
Virgilia capensis 27, 276,	314	
Virginian Creeper...	317	
Japanese... 297,	317	
Vlier	284	
Walnuts 23, 24,	39	
Common	246	
Black... 246,	333	39
Belgaum	251	
East Indian	252	
Wandoo...	352	
Water-boom	282	
Wattles 17, 30, 43, 62, 101,	326	
Wattle-bark analysis	354	
Wattle culture (see Black Wattle)		
Wattle increment	214	
Weeding	39	
Weeping Cypress	232	
Weeping varieties, how perpetuated...	48	
Weigelia...	314	
Wellingtonia gigantea... ...	234	
West Indian Cedar ... 108,	219	
Wet ground	59	
Weymouth Pine	217	
White Acacia	247	
White Ants	145	
White Cedar 219, 232,	235	
of California	219	
Mexican	219	
Northern... 219,	236	
White Cypress...	232	
White Gum...	159	
White Ironwood 107, 186,	287	
White Mahogany	171	
White Milkwood	286	
White Mulberry	101	
White Pear... 109,	280	
White Poplar	47	
White Stringy bark	179	
Whitewood, American ...	243	
Cherry	243	
Widdringtonia (see Callitris) 221,	234	
cupressoides... ... 220,	234	
juniperoides	234	
natalensis 220,	234	
Whytei 235,	329	42
Wild Banana 111,	337	90
Wild Chestnut ... 39, 238,	280	
Wild Date Palm	111	82
Wild Fig... 109,	326	87, 89
Wild Honeysuckle	289	
Wild Olive	284	
Wild Peach	283	
Willow ... 15, 37, 59, 91,	121	
bush	290	
Australian	151	
Port Jackson	151	
Weeping 43, 44, 102,	238	31
Wistaria sinensis ... 297,	319	
Woolly-butt	182	
Working-plan	83	
Wych-elm	48	
Xelegengane	282	
Xululembile...	285	
Xymalos monospora	287	
Yate 175,	352	
Yate, Flat-topped ... 185,	351	
Yellow Box	183	
Yellow Cedar (N. American)	219	
(Australian)	219	
Yellow Cypress 220,	235	
Yellow-wood 16, 18, 101, 107, 113, 164,	236, 329	
common 236,	285	
Outeniqua	236	
Queensland	267	
Real...	285	86, 94
Seed	27	
Yellowwood belt ... 111,	131	
Yew... ... ... 236, 324,	329	
York Gum	352	
Yucca aloefolia var ... 316,	325	41
filamentosa...	316	
Zamia	315	
Zanthoxylum capense ...	287	
Zizyphus jujuba	277	
mucronata ... 277, 288,	331	53
Zululand conditions 17, 116,	121	
Zululand treeplanting 116, 121,	132	
Zuurbesjes 289,	324	

Conservator of Forests.

NOTICE No. 1, 1905.

To encourage tree planting, Transplants and Seeds of Forest Trees are supplied by Government, so far as in Stock, at the undermentioned rates, exclusive of carriage from the Government Nursery, Cedara.

Transplants of Eucalypts, Pines, Acacias, Casuarinas, Cupressus, etc., about 25 trees in each tin, at 8s. 4d. per 100 trees. Trees in separate tins at 1s. each.

Transplants of scarce kinds, larger trees, or surplus stock, when available, will be charged at special rates, which will be furnished on application.

Tree seeds, in variety, at 1s. per packet. Price per pound, which fluctuates, will be furnished on application.

Packing and postage of seed, when required, charged 1s. per lb. extra.

Orders for present or spring delivery should be addressed to the Forester, Cedara, and must be accompanied by a remittance in cash or postal order.

T. R. SIM,
Conservator of Forests.

Office of Conservator of Forests,
17th February, 1905.

LIST OF KINDS USUALLY IN STOCK, OR WHICH CAN BE RAISED ON A FEW MONTHS' NOTICE.

(Those marked * are usually kept only in separate tins at 1s. each).

Botanical Name.	Common Name.	Remarks.
Aberia caffra	Kei Apple	Forms a strong prickly fence. Half hardy.
Acacia dealbata	Silver Wattle ...	More hardy than Black Wattle. but not grown for tan bark.
decurrens	Black Wattle ...	Produces the Black Wattle bark of commerce. Does best in the high midlands: poorer towards the coast and in the thorn-veldt.
melanoxylon	Blackwood	A valuable timber: does well throughout Natal.
Albizzia fastigiata	Flat Crown	An ornamental timber tree near the coast.
Acer negundo	Box Elder...	A decidious Maple; grows in the Midlands.
*Araucaria Cookii	... ...	Highly effective as ornamental timber tree near the coast.
* Cunynghamii	... ...	Highly effective as ornamental timber tree near the coast.
Callitris cupressoides ...	Berg Cypress... ...	Hedge scrub for high moist localities.
Calodendron capense ...	Cape Chestnut ...	Ornamental flowering tree and useful timber.
Carissa grandiflora	Amatungula	Good hedge plant in the warmer districts.
*Castanea vesca	Spanish Chestnut	Seldom more than an ornamental scrub here.

Botanical Name.	Common Name.	Remarks.
Casuarina leptoclada ...	Beefwood	A hardy, ornamental timber tree.
quadrivalvis...	She-Oak	Drooping habit; ornamental.
Catalpa bignonioides ...	Catalpa	Foliage ornamental, tree seldom a success here.
*Ceratonia siliqua	Carob-Bean	Beans are ground for cattle food.
*Cinnamomum camphora	Camphor	Yields durable timber and the camphor of commerce.
*Crataegus oxycantha ...	Hawthorn...	Does best in the colder districts.
Crytomeria japonica ...	Japan Cedar	Valuable timber tree.
Cupressus lawsoniana ...	Lawson's Cypress	Requires moist cold site; very slow.
macrocarpa	Scented Cypress	Highly ornamental as a tree or hedge.
lusitanica	Cedar of Goa ...	Like C. macrocarpa, but better for timber purposes.
goveniana...	... ...	Hardy, ornamental, and useful.
horizontalis	Spreading Cypress	A useful timber tree, often planted in cemeteries.
pyramidalis	Upright Cypress	Pyramidal habit; used in cemeteries.
torulosa	... ...	Useful timber tree; highly ornamental.
pendula glauca	... ...	Branches drooping; glaucous in colour.
*Cedrus Deodara	Deodar Cedar ...	Ornamental and hardy; valuable timber tree.
Eucalyptus amygdalina	Giant Gum	Does best in the mist belt; timber useful.
acmenioides	White Mahogany	Half hardy; useful timber.
botryoides	... ...	A spreading tree; fit for the midlands.
calophylla	... ...	Small tree, often a failure; foliage ornamental.
citriodora...	Scented Gum... ...	Timber straight, valuable; leaves lemon-scented.
cornuta	Yate	Bushy tree, hardy, and good shelter.
corymbosa	Bloodwood-tree	Valuable timber tree for the coast.
corynocalyx	Sugar Gum	An ornamental, fairly hardy, small useful tree.
crebra	Ironbark	Valuable timber; suits the coast districts.
diversicolor	Karri	Valuable timber and very ornamental tree for midlands and coast.
ficifolia	Crimson Gum ...	Flowers crimson, has not done well in Natal.
globulus	Blue Gum	Widely distributed throughout Natal.
Gunnii	Cider Gum	Very hardy.
hemiprloloia	Grey Box...	Hardy, tall, and straight, a valuable timber.
leucoxylon	... ...	Timber valuable, but seldom straight.
longifolia	Woolly-Butt	Erect, pyramidal, medium sized tree, free flowering.
macrorhyncha	Victorian Stringy-bark	Erect clean stem; not durable in the ground.

Botanical Name.	Common Name.	Remarks.
marginata	Jarrah	A valuable timber, but has not succeeded in Natal.
maculata	Spotted Gum ...	A useful timber, fit for the midlands.
melliodora	Yellow Box	Slow, but hardy; timber valuable.
microcorys	Tallow-wood	Untried in Natal, but recommended.
obliqua	Stringy-bark	Fairly hardy, timber much used in Tasmania.
occidentalis	Flat-topped Yate	A small tree yielding on good soil the valuable tanning bark "Mallet-bark."
pauciflora	Leather Gum ...	One of the most hardy gums.
polyanthema	Red Box	Medium sized tree; good for shelter, or street-planting.
pilularis	Blackbutt	A valuable timber, grows in the Midlands and Coast.
paniculata	White Ironbark Torvale Gum	A valuable timber, does well on the coast.
resinifera	Red Mahogany ...	Grows well in Natal; has a good Australian reputation.
robusta	Swamp Mahogany	Does well on the coast on deep ground.
rostrata	Red Gum	One of the best from the coast to the Berg.
saligna	... ...	Tree of large size; timber of best quality.
sideroxylon	Broadleaved Ironbark	A very valuable timber; suited to the midlands.
sideroxylon	Red Ironbark ...	One of the best throughout Natal.
tereticornis	Forest Red Gum...	A variety of E. rostrata, and equally useful.
viminalis...	Manna Gum	Hardy and rapid growth; timber second-rate.
Fraxinus ornus	Manna Ash	Requires a moist spring.
Grevillea robusta...	Silk Oak	Ornamental timber tree for the coast and midlands.
*Juniperus virginiana ...	Red Cedar	Valuable timber, but slow growing, ornamental.
Liriodendron	Tulip-Tree	Valuable timber; does well in deep soil.
Melaleuca leucadendron	Broadleaved Paper bark	Hedge plant for coast and midlands.
Pinus canariensis	Canary Island Pine	Does well except in the thorn-veldt.
halepensis	Aleppo Pine	The surest to grow, though not the most rapid.
insignis	Insignis	Grows rapidly, but often dies early.
massoniana	... ...	Fairly rapid growth, and good timber.
pinaster	Cluster Pine	Largely planted by in situ sowings.
rigida	... ...	Slow grower.
Quercus pedunculata ...	Oak	Does well in high, cool, moist situations.
Robinia pseud-acacia ...	... ...	Hardy; a durable timber and pretty flower.
Schinus molle	Pepper Tree	Ornamental drooping foliage; roots white-ant proof.
Thuya occidentalis	Arbor Vitae	One of the best dwarf hedges.

3 2044 102 826 989